Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

JAN 30 1935
DETROIT

The range of 'Mouldrite' phenolic moulding powders made at I.C.I.'s modern plant at Wilton meets the exacting practical requirements of the moulding industry. 'Mouldrite' is the registered trade mark of the moulding powders manufactured by I.C.I.

MOULDRITE® ***Phenolic Moulding Powders***

IMPERIAL CHEMICAL INDUSTRIES LIMITED LONDON S.W.1

ICI

P.412

BEXOID MOULDING POWDER

A match for any colour

Now . . . a new and bigger Bexoid Moulding Powder Colour Swatch than ever! In fact, five swatches in one, covering opaque, translucent, transparent, metallic and pearl effects — any section of which will be forwarded gladly on request.

BX leaders in thermo-plastics

All colours in the swatch are British Colour Council shades. In addition to this extremely wide standard range, Bexoid Moulding Powder can be produced to match any special colour sample a customer may submit.

BX Plastics Ltd., Higham Station Avenue, London, E.4. *Larkswood 4491*

VR v.16 1951

THERE IS A

'dag'

DISPERSION OF GRAPHITE OR CARBON

for your individual problem

The 'dag' dispersions of graphite may be used whenever it is required to confer upon a material one or more of the following properties of graphite: parting, opacity, thermal conductivity, electrical conductivity, lubrication. In addition, dispersions of carbon in water, volatile solvents and plasticisers are available to meet your needs. Why not call in one of our Engineers to tell you more of the service which 'dag' dispersions provide in industry? Use the coupon below to obtain the latest Acheson Sales Bulletins.

MAIL THIS COUPON

To:— ACHESON COLLOIDS LIMITED
18 Pall Mall, London, S.W.1.

Please send me full particulars about 'dag' dispersions of graphite or carbon.

Name.....

Address.....

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dag REGISTERED TRADE MARK DISPERSIONS

V.R. 115

A

Tech

Issued by Thos. Firth and John Brown Ltd., SHEFFIELD.

TURNER *self-contained* PLASTICS PRESSES

The only Press with all these advantages

SELF-CONTAINED: Fitted with a sealed unit hydraulic system which incorporates a compact and efficient high-pressure pump.

VARIABLE PRESSURE: By means of a handwheel on the pump, pressure can be adjusted between the maximum and minimum force specified for each type of press.

SEALED HYDRAULICS: The hydraulic system is wholly contained in a sealed oil tank, and foreign matter is thus completely excluded.

SIMPLICITY OF CONTROL: A single lever controls both upward and downward movements of the ram.

SIMPLE TO INSTALL: To install the press it is only necessary to make one connection to the electric supply.

EASY TO MAINTAIN.

SAFETY IN OPERATION: Mechanically interlocked safety guards prevent the ram being moved unless guards are completely closed. Electrical switchgear and controls totally enclosed.

Entirely new in design and principle of operation, Turner Plastics Presses represent the greatest advance yet made in the production of presses for compression moulding of plastics, deep drawing and other pressing operations. Each press combines the uses of many by providing a range of variable pressures. The larger type gives any required pressure between 25 and 125 tons, the smaller model any pressure between 10 and 50 tons. They are fully self-contained and incorporate a unique hydraulic system which is completely sealed against dust and dirt, but is easily accessible for inspection and maintenance. Compact in construction, Turner Presses enable the greatest productive use to be made of every foot of factory floor space. Fully descriptive literature gladly sent on request.

TURNER MANUFACTURING COMPANY LIMITED, VILLIERS STREET, WOLVERHAMPTON

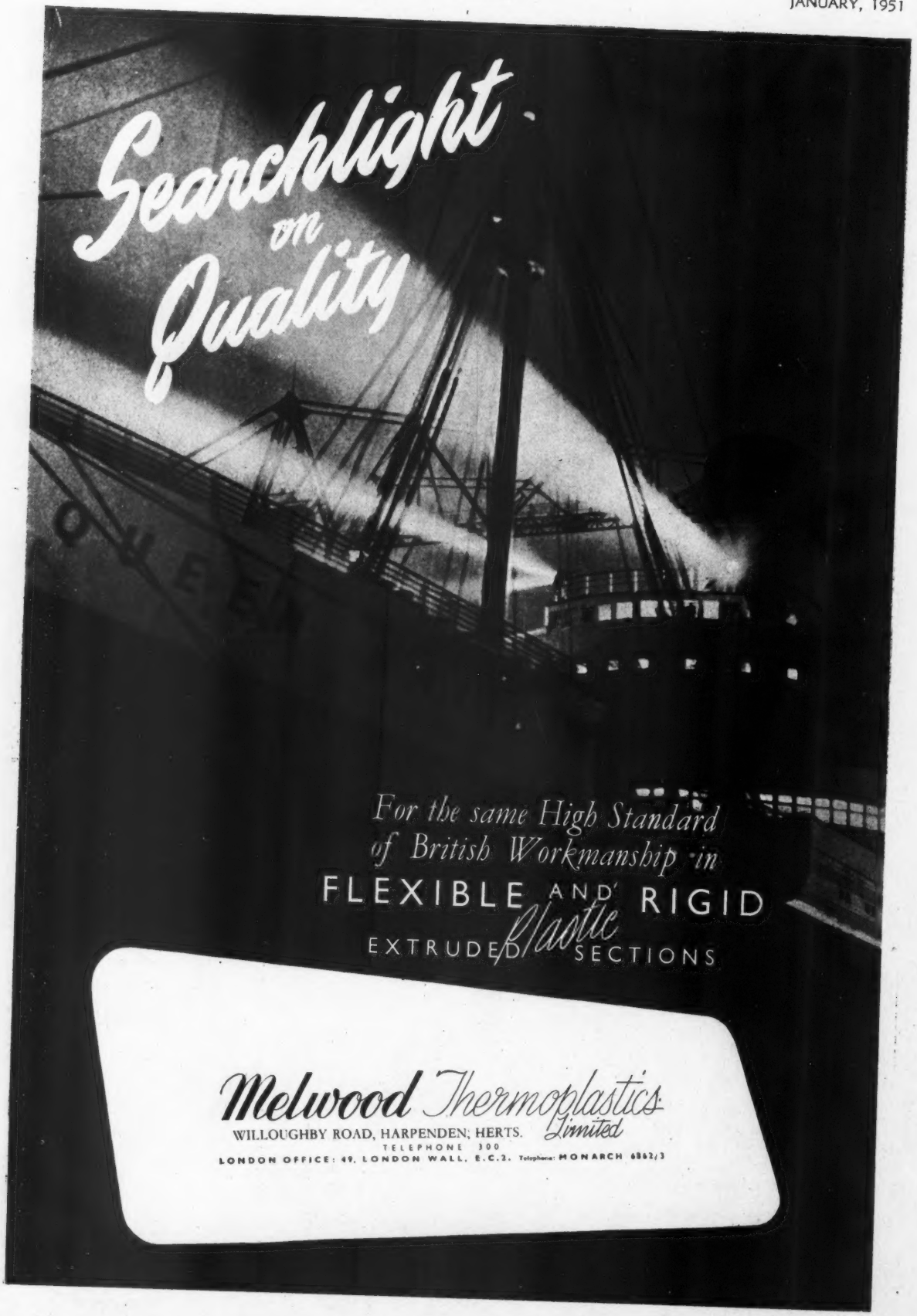
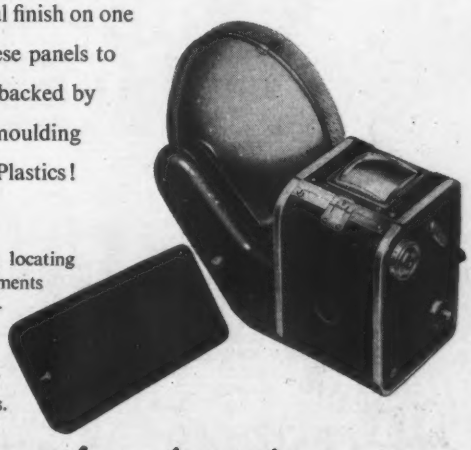

Searchlight on Quality
For the same High Standard of British Workmanship in
FLEXIBLE AND RIGID
EXTRUDED Plastic SECTIONS
Melwood Thermoplastics Limited
WILLOUGHBY ROAD, HARPENDEN, HERTS.
TELEPHONE 300
LONDON OFFICE: 49, LONDON WALL, E.C.2. Telephone: MONARCH 6862/3

Photo Finish!

In moulding, as in photography, accuracy is everything. This new Kodak 'Duaflex' camera, for instance, utilizes plastic side panels, a feature of which is the grooving system that locates and holds various components. The essentials are permanent accuracy and rigidity, plus a special finish on one side. Kodak Ltd. entrusted the job of producing these panels to Ekco Plastics, in whose wide knowledge and experience, backed by facilities for quantity production, lies a ready answer to every moulding problem. If *you* have a moulding problem consult Ekco for Plastics!



The side panels are robust black phenolic mouldings incorporating locating grooves for spool chambers and holders, mirror, reflex, lens, film compartments etc. This side of the moulding was given a matt finish by dull chromium-plating the tool. Extreme accuracy was necessary in the design and making of the moulding tools and great care had to be exercised during and after moulding to prevent warping.
The Lens Cover and Flasholder were also moulded by Ekco Plastics.

EKCO *Plastics for Industry*

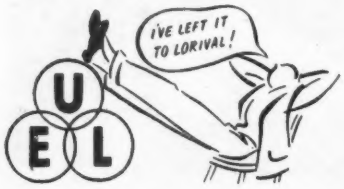
E. K. COLE LTD. (*Plastics Division*) SOUTHEND-ON-SEA · ESSEX

They used to do it the hard way,

.... now they leave it to Lorival

L.21

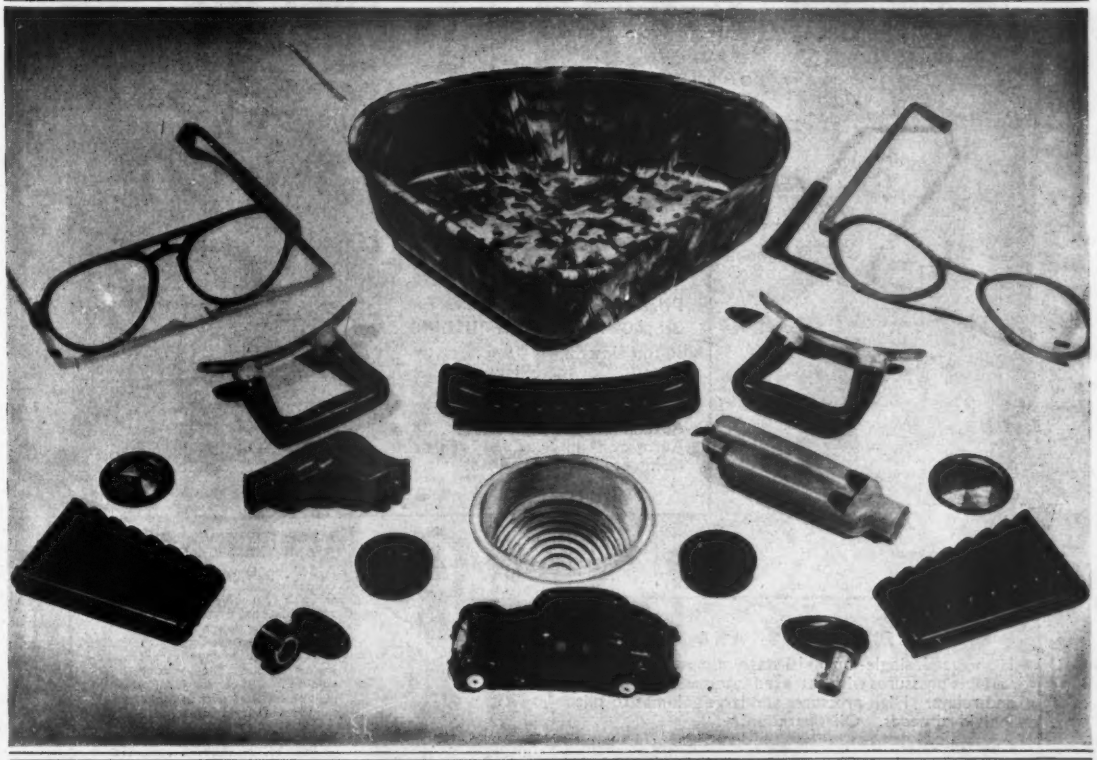
The best of all our products are those where, for one reason or another—some problem calling unmistakably for expert advice, or just an old customer's established habit—we have been given the chance to help plan the job from the start. A Lorival representative prefers to come in constructively on a technical discussion rather than simply taking an order. Behind him is an organisation whose experience in plastic and ebonite moulding and tool design is unsurpassed.



LORIVAL PLASTICS

UNITED EBONITE & LORIVAL LTD · LITTLE LEVER · NEAR BOLTON · LANCS.

MOULDS



by

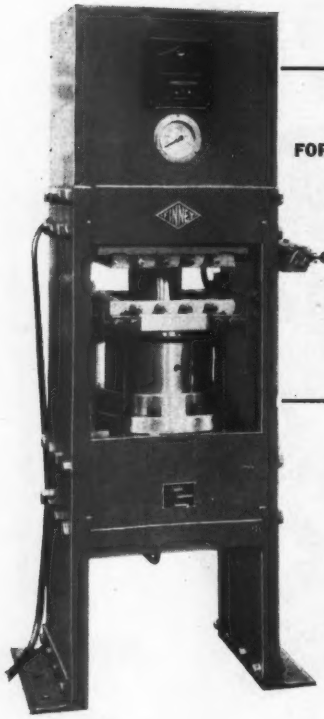
UNIVERSAL TOOLS LTD.

TRAMWAY PATH, MITCHAM, SURREY.

Telephone: MITCHAM 1624, 1625, 1626

FINNEY HYDRAULICS

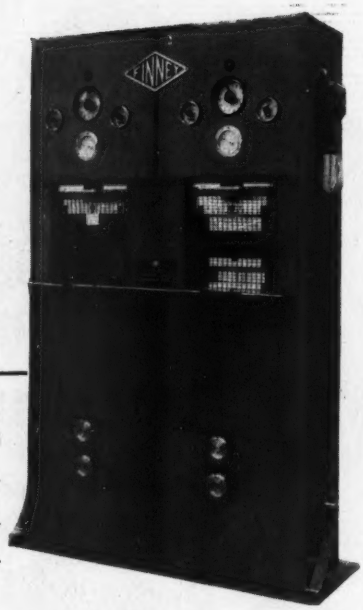
Everything for the Plastics Trade



HOBBING PRESSES FOR IMPROVED TOOL MAKING

Compact, space-saving design. From 200-1,000 tons.

Ample daylight and bolster area. Fabricated in high-tensile steel. Completely self-contained.



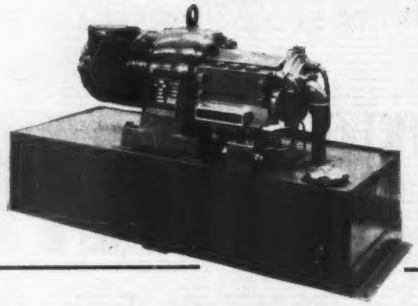
DUAL UNIT FOR TRANSFER OR COMPRESSION MOULDING

50-ton Upstroking clamp.
12-ton Downstroking transfer plunger.
Automatic time cycle control.
Automatic cycling control.
Automatic interlocking guards.
Completely self-contained.

HYDRAULIC PUMPS AND VALVES

High-speed, single- or multi-stage pumps, constant or variable pressures with patented automatic changeover and relays. High pressures and large volumes to suit individual needs. Oil operation.

Control valves for oil or water. Solenoid or hand operated. All sizes and duties. Relief valves of all types, including release of air from hydraulic systems.

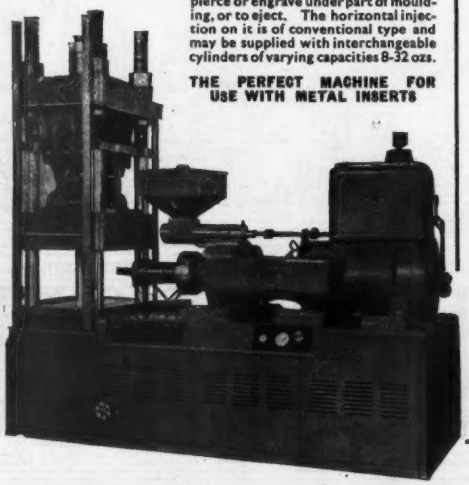


IMPCO

A NEW TECHNIQUE IN INJECTION AND TRANSFER MOULDING

A 500-ton Downstroking Press for clamping and 100-ton Upstroking transfer ram which may be used to give additional pressure to eliminate shrinkages or flow marks.
It may also be used to shear gates, pierce or engrave under part of moulding, or to eject. The horizontal injection on it is of conventional type and may be supplied with interchangeable cylinders of varying capacities 8-32 ozs.

THE PERFECT MACHINE FOR USE WITH METAL INSERTS



Sold through **FINNEY PRESSES LTD.**

BERKLEY ST., BIRMINGHAM, 1 Phone: MID 3795/6. Cable: FINHYD, B'HAM

Rely on

STYRON

POLYSTYRENE
GRANULES

the Preferred Plastic

R. H. COLE AND COMPANY LIMITED
2, CAXTON ST., WESTMINSTER, LONDON, S.W.1.
'PHONE : ABBEY 3061 (10 LINES). 'GRAMS : GERATOLE, PHONE, LONDON.

Product of Dow Chemical of Canada Ltd

Windsor

A World Wide Reputation as Producers of . .

INJECTION MOULDING

And

EXTRUSION MACHINES

DIES, MOULDS, Etc.

For the Plastic Industry

Specification

R·C 65	
Average output	65 lbs. per hour.
Number of Screws	2
Diameter of Screws	3.15—3.54
Motor H.P.	5
Speeds	6, 9, 12 r.p.m.
Floor Space—Machine	2' 6" x 3' 6"
Control Panel ..	2' 3" x 2' 3"
Hopper Feed	Fully automatic rotating type and geared to screw speeds.
Lubrication	Forced feed to all gears and bearings.
Shipping Weight	2,185 lbs. net.

R·C 65 →

ALL ENQUIRIES TO :—

PLASTIC MACHINES

R. H. Windsor Ltd

Important Announcement

WINDSORS are pleased to announce that they are NOW able to supply British Designed and Manufactured Multi-screw Extrusion Machines based on the well-known I.M.P. principle in the following capacities

R·C 65 (65 lbs.) R·C 100 (100 lbs.)
R·C 200 (200 lbs.)

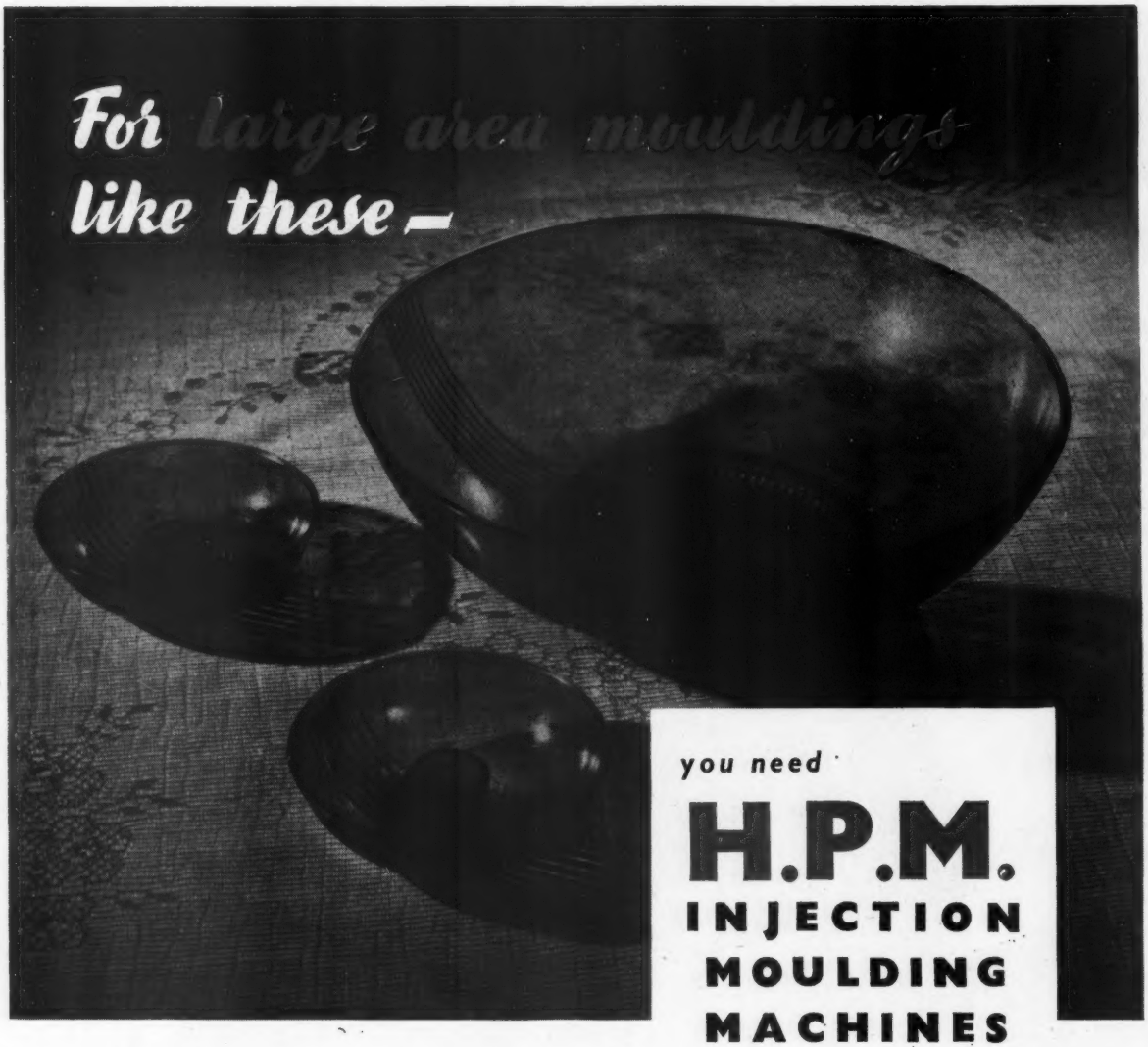
in our exclusive territory of U.K. B.E. Colonies, U.S.A. & S. America excluding Brazil

R·C 100 →

Specification

R.C 100	
Average output	100 lbs. per hour.
Number of Screws	2
Diameter of Screws	3.62—4.09
Motor H.P.	10
Speeds	Infinitely variable between 6 and 16 r.p.m.
Floor Space—Machine	3' 6" x 3' 6"
Control Panel	2' 3" x 2' 3"
Hopper Feed	Fully automatic rotating type and geared to screw speeds.
Lubrication	Forced feed to all gears and bearings.
Shipping Weight	3,685 lbs. net.

18, FINSBURY SQUARE, LONDON, E.C.2.
Phone: MONarch 8721 Grams: TECHNIRACH, FINSQUARE, LONDON Cables: TECHNIRACH, LONDON

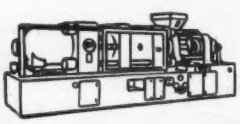


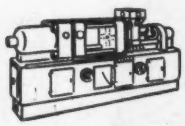
Size and weight are no longer limiting factors. With capacities up to 60 ounces per cycle these new British H.P.M. injection moulding machines offer unlimited opportunities to the plastics moulder to tackle really big jobs.—Refrigerator parts, radio cabinets, toilet seats, large instrument housings are typical products that can now be moulded on a production basis.

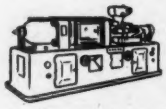
Are you prepared to meet the increasing demand for these large plastic parts? Injection moulding is the fastest method of production, and "all hydraulic" H.P.M. moulders are the fastest in the industry.

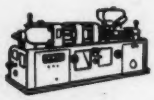
British built H.P.M.s offer expanding production possibilities, reduced manufacturing costs and increased profits from plastics—why not write to-day for details of the complete H.P.M. range of equipment.

BRITISH HPM BUILT


60 ounce


32 ounce


16 ounce


10 ounce

Manufactured under licence by John Shaw & Sons (Salford) Ltd., Salford 3, Lancs.

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A. C. WICKMAN LIMITED, COVENTRY

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THE GENERAL ELECTRIC CO LTD MAGNET HOUSE KINGSWAY LONDON WC2

A complete range of

Polyvinyl Chloride

PRODUCTS

● **VINATEX P.V.C. COMPOUND**
FOR EXTRUSION including sheathing (dielectric and arctic grades) of belting and piping.
FOR CALENDERING
FOR INJECTION MOULDING

● **VINATEX P.V.C. PASTE**
FOR LEATHERCLOTH coated paper and casting. Special grades for low temperature flexibility and non-tacky finishes. Supplied pigmented or clear.

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P.V.C. FLEXIBLE SHEETING and Leathercloth including press polished sheets, calendered plain or printed sheeting in all colours. Embossed supported and unsupported sheet in single or two colour effects.

Our Technical Sales Department will be pleased to advise you on your specific needs.

V.P.26b

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Ask Crystalate to quote for Your job in Moulded Plastics

CRYSTALATE

PLASTIC MOULDERS, FABRICATORS & TOOLMAKERS SINCE 1899

Crystalate Ltd., Crystalate House, Mill Lane, Tonbridge, Kent. *Phone : Tonbridge 2261/2/3/4/5.*

HUPFIELD Plastics

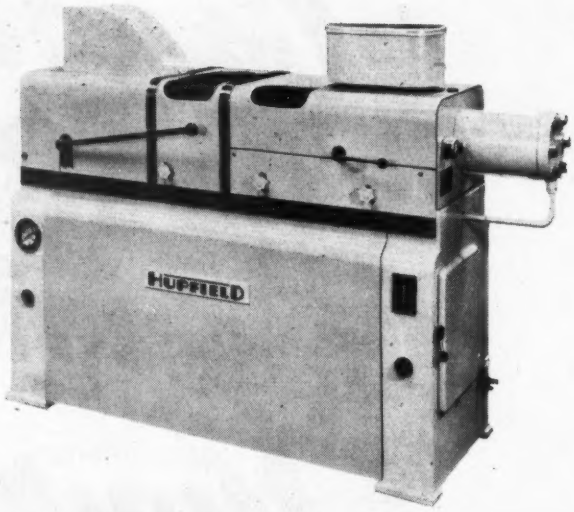
INJECTION MOULDING MACHINES

1 & 2 OUNCE CAPACITY

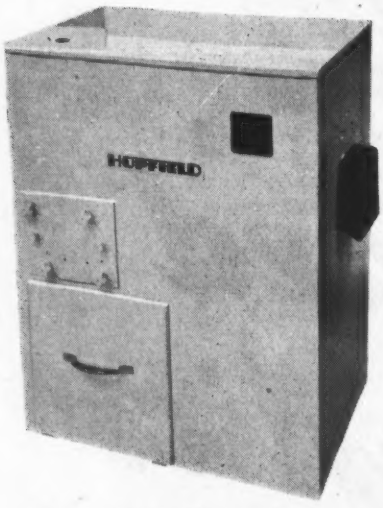
1951 MODELS

Single lever operated, self-contained, semi-automatic with automatic temperature control, and compensating feed mechanism. Designed to suit female labour. All parts are standardized.

	1 oz.	2 oz.
Mould area approximately..	12 sq. in.	22 sq. in.
Plasticizing capacity per hour	9 lb.	18 lb.
Injection pressure	5½ tons	11 tons
Mould locking pressure ..	22 tons	44 tons
Shots per hour, subject to mould design	350	250



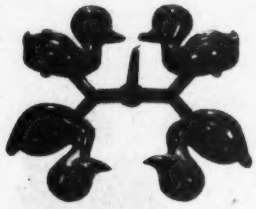
GRANULATING MACHINES



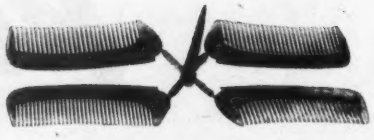
Granulates all thermoplastic materials, delivers at the rate of 80 lb. per hour. Cutting blades are adjustable and easy to clean. Completely self-contained with 2 h.p. electric motor.

Mouldings from our 1 ounce machine

polystyrene 3¾" dia.
25 seconds. 1 ounce.



cellulose acetate 5½" × 5"
30 seconds. 31 gramme.



polystyrene 8" × 3½"
20 seconds. 24 gramme.

Write for particulars, or telephone our Works (Wordsworth 4488) for a demonstration.

HUPFIELD BROTHERS LIMITED WORKS AND OFFICES

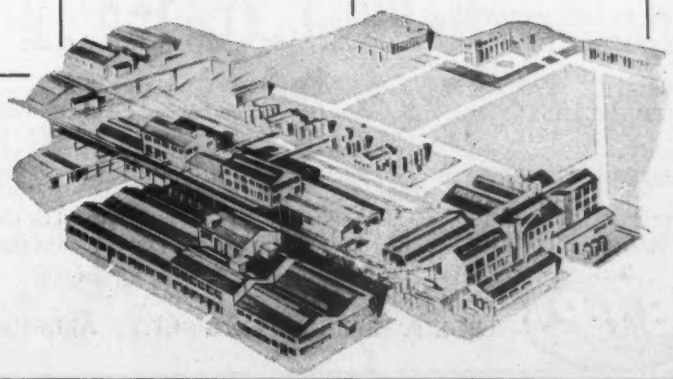
DALSTON GARDENS · STANMORE · MIDDLESEX · ENGLAND

FACTS ABOUT "DISTRENE 200"

Available now!

"Distrene 200" is an improved form of polystyrene injection moulding material. It is more resilient and more heat resistant than similar materials previously available. It is suitable for the production of mouldings by normal injection methods, though it may be necessary to use slightly increased cylinder temperatures. The improved mechanical properties have been achieved without sacrifice of the general advantages of normal polystyrenes and further enhance the recognised qualities of this thermoplastic material and widen its range of usefulness. "Distrene 200" is supplied in a range of standard colours, opaque, translucent and clear. Where water white crystal clarity is essential, however, "Distrene 80" is recommended. Please write for samples and additional information.

PROPERTY	RANGE OR VALUE	METHOD
MOULDING PROPERTIES		
INJECTION MOULDING TEMP.	400—500°F (204—260°C.)	
PHYSICAL PROPERTIES		
SPECIFIC GRAVITY	1.03—1.07	
REFRACTIVE INDEX	1.59	ABBÉ REFRACTROMETER
ELONGATION AT BREAK	2—3%	TENSILE SPECIMEN TO BS 1524
TENSILE STRENGTH	5,500—8,000 lbs./in.²	BS 1524
IMPACT STRENGTH	0.22—0.35 ft. lbs.	BS 1493
SOFTENING POINT	105—125°C.	BS 1493
ELECTRICAL PROPERTIES		
POWER FACTOR @ 800 c/s	0.0002—0.0005	
POWER FACTOR @ 2 × 10⁶ c/s	0.0003—0.0005	
DIELECTRIC CONSTANT @ 800 c/s	2.6	
DIELECTRIC CONSTANT @ 2 × 10⁶ c/s	2.6	
DIELECTRIC STRENGTH @ 25°C.	600—700 volts/mil.	SIMILAR TO BS 771
VOLUME RESISTIVITY	1 × 10¹⁵ ohms/cm³	SIMILAR TO BS 771
CHEMICAL PROPERTIES		
EFFECT OF DILUTE ACIDS	NONE	
EFFECT OF ALKALIS	NONE	
EFFECT OF ULTRA-VIOLET RADIATION	YELLOWS SLIGHTLY	
WATER ABSORPTION	NIL	90 hours @ 20°C.
SOLUBILITY		
INSOLUBLE IN	ALCOHOLS (MONOHYDRIC) GLYCOLS GLYCEROLS ALIPHATIC HYDROCARBONS	
SWELLS IN	KETONES ETHERS	
SOLUBLE IN	AROMATIC HYDROCARBONS CHLORINATED HYDROCARBONS ESTERS DIOXANE PROPYLENE OXIDE	



BRP

BRITISH RESIN PRODUCTS LTD.

SALES AND TECHNICAL SERVICE,
21 ST. JAMES'S SQUARE, LONDON, S.W.1.
Tel: WHI 8021 Works: BARRY, GLAM.

DETROIT PUBLIC LIBRARY

NOW IN PRODUCTION

AUTO-CONTROL

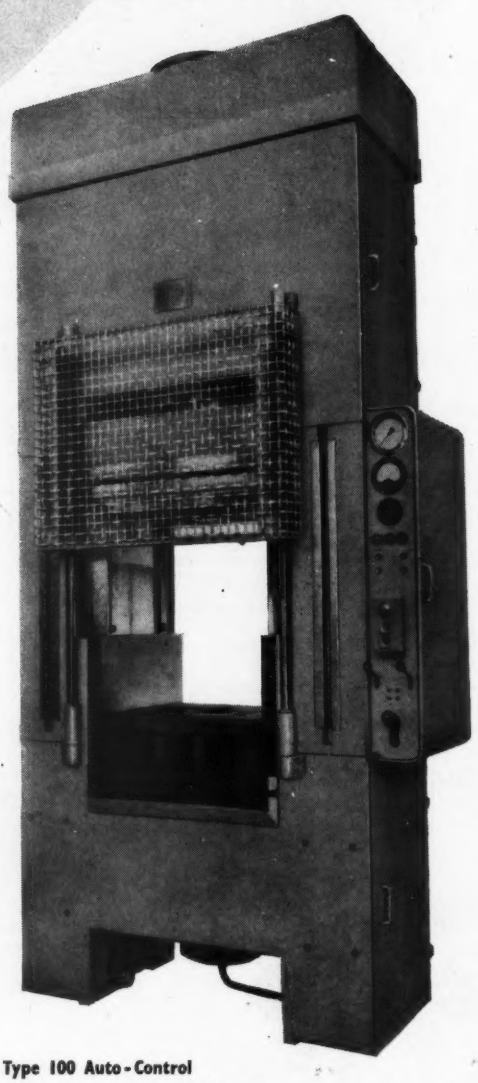
BIPEL

PRESSES

Three moulding presses incorporating automatic control of the moulding cycle with optional transfer moulding rams; designed by moulders for moulders. The prototypes of these presses were designed initially for the moulding division of our own Group and are the result of several years' research on press plant and in particular on the automatic control of the moulding cycle. They have been at work now for over two years producing trade mouldings 24 hours a day, 6 days a week: their performance has convinced us that they are unsurpassed by any press made anywhere in the world.

There are three models:—

Type 40	Pressure range	20 - 60 tons
Type 100	Pressure range	50 - 150 tons
Type 200	Pressure range	100 - 300 tons



Type 100 Auto-Control Bipel Press, fitted transfer ram

BRIEF SPECIFICATIONS

FRAMES: Heavy steel plate, electrically welded, stress relieved, enclosing completely all hydraulic and electrical equipment. Water-cooled platens.

RAMS: Annulus type, hard chromed, fitted with C.I. piston rings.

HYDRAULIC SYSTEM: 1,000-p.s.i. ring main supplied from self-contained unit embodying air-loaded accumulator and special B.I.P. unloading valve *which cannot by-pass fluid under pressure but always unloads*. Working pressures of 2,000 to 3,000-p.s.i. are obtained by intensifier built into press.

AUTOMATIC CONTROL: Pneumatically operated. Can reproduce with precision any moulding cycle that can be performed manually.

ELECTRICAL GEAR: All built-in including thermostatic control for platens and moulds.

GUARDS AND CHOCKS: Interlocked and automatically operated from sequence controller.

B·I·P GROUP

B. I. P. ENGINEERING LTD., ALDRIDGE ROAD, STREETLY, STAFFS.

Moulding RCL powders

Phenol Formaldehyde and Cresol Formaldehyde Types in black and colours and available in all flows for all purposes.

RESINOUS CHEMICALS LIMITED
BLAYDON, COUNTY DURHAM

Varnish media
Synthetic resins and glues
Moulding powders
Fine colours · Chemicals

RCL

Telephone: Blaydon 347-8 *Telegrams: Reschem, Blaydon-on-Tyne*

B7

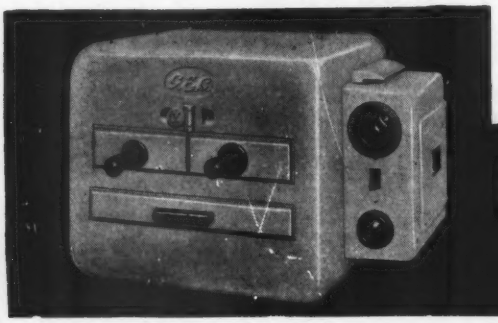
30% MORE from the press

By Infra-red Pre-heating

THE G.E.C. PLASTIC PRE-HEATING OVEN—

- Proved by factory experience to effect a remarkable rise in press output
- Improved mouldings—reduced risk of pin breakage
- Small size—easily accommodated close to the press
- Thermostatic control of temperature—continuously adjustable
- Low power consumption—economical to operate
- Inexpensive—£40. Immediate delivery
- Specify Cat. No. PH6618. Ask for descriptive leaflet

G.E.C.



Patent applied for.

PLASTIC PRE-HEATING OVEN

THE GENERAL ELECTRIC CO. LTD. MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

Colours that SELL

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Our colours are all tested for fastness and heat resistance and only the finest pigments and dyestuffs are used.

If you have a colour problem, don't hesitate to get in touch with us. The combined experience of our technical experts is at your disposal at all times.

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Mouldings and moulding powders,
Resins, solid, powdered, or in solution,
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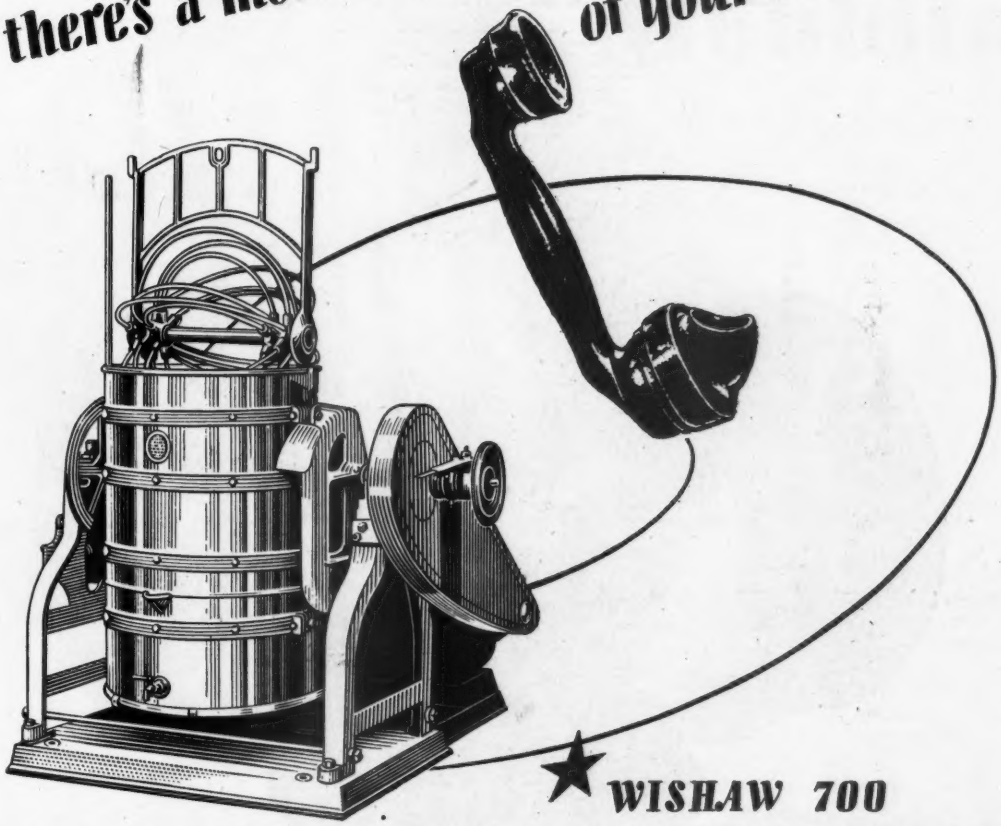
there's a Morton machine at the end of your telephone



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We are glad to announce that we are now regulating our production schedules so that the delivery of many models in our range of mixers is very much improved. If your mixing problem is urgent ring Wishaw 700; our sales engineer in your area will call at *your* convenience.

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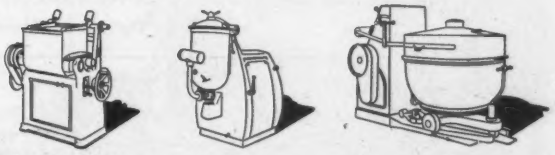

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P.V.C. Insulated

Insulation accurately extruded to ensure concentricity

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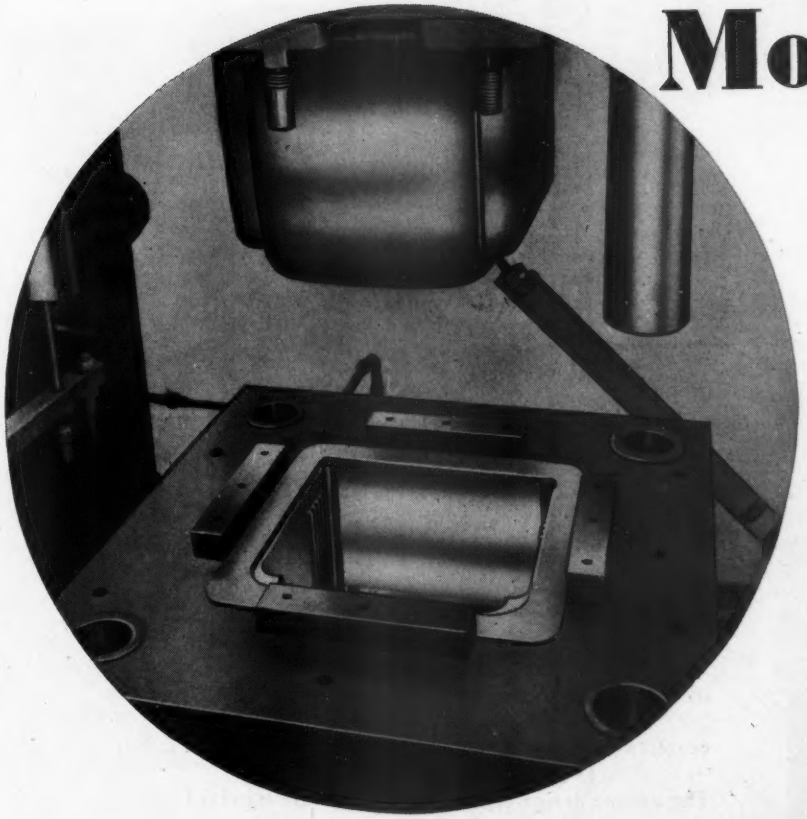
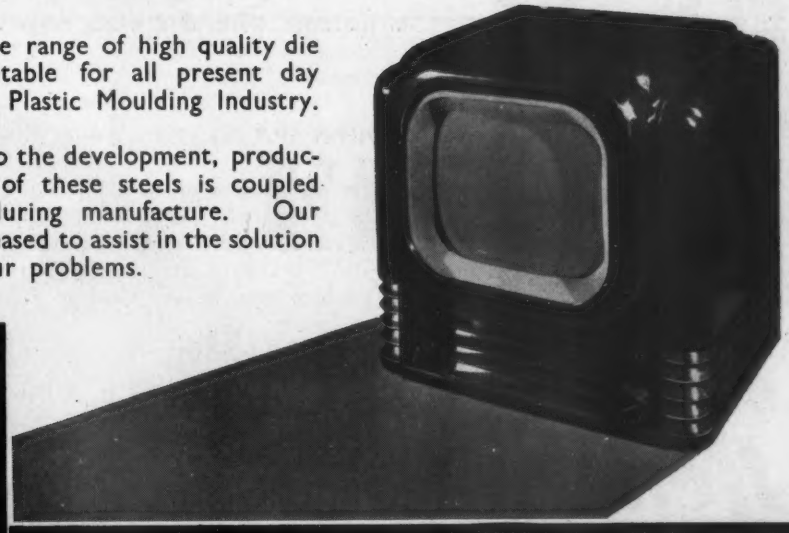


The photographs show the mould and a Bush Television cabinet manufactured by British Moulded Plastics, Ltd. The Dies are made from PLMB/1 Steel manufactured by English Steel Corporation Ltd.,

E.S.C. produce a wide range of high quality die steels, eminently suitable for all present day requirements of the Plastic Moulding Industry.

Constant research into the development, production and application of these steels is coupled with rigid control during manufacture. Our technicians will be pleased to assist in the solution of your problems.



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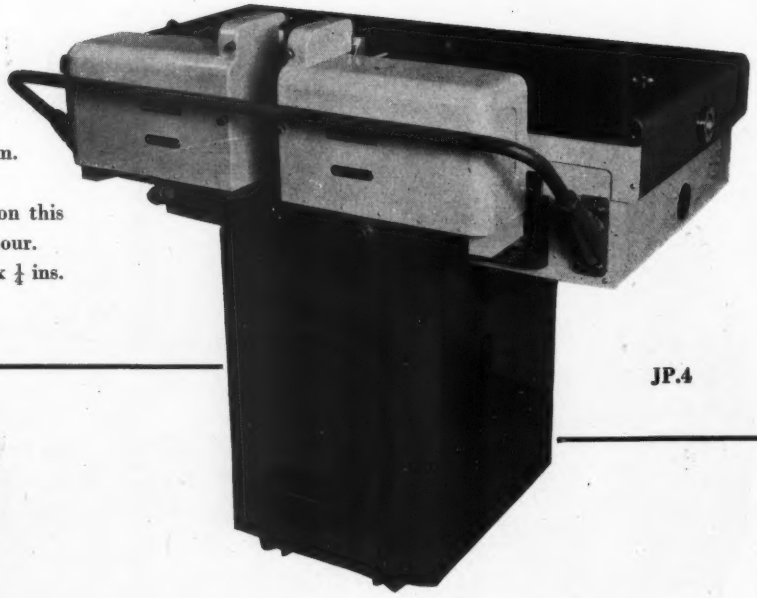
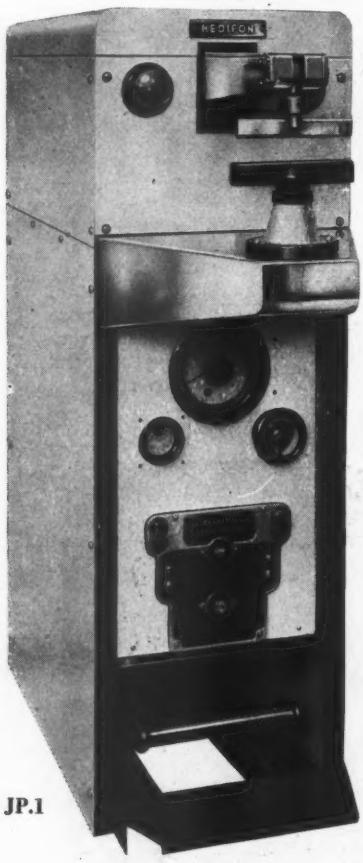
REDIFON JP.4
A new, semi-automatic welder for the manufacture of square or rectangular transparent boxes and lids from cellulose acetate film. An average of 300 medium size boxes per hour can be produced on this machine by entirely unskilled labour. Sizes range from 3 ins. x $1\frac{3}{4}$ ins. x $\frac{1}{4}$ ins. to 18 ins. x 12 ins. x 5 ins.



JP.4



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REDIFON JP.1 This versatile machine is the most widely used High Frequency welder for the manufacture of rain-coats, toys, wallets and other fancy goods from sheet P.V.C. The unique design of the JP.1 allows one standard unit to do the same work as a whole range of special-purpose machines.

REDIFON JP.3 The JP.3 is a fully automatic press welder with a platen area of 18 ins. x 14 ins. Many intricate shapes can be welded in one operation. Unskilled workers can produce toys, household gloves or similar articles at the rate of 600 per hour with this machine.

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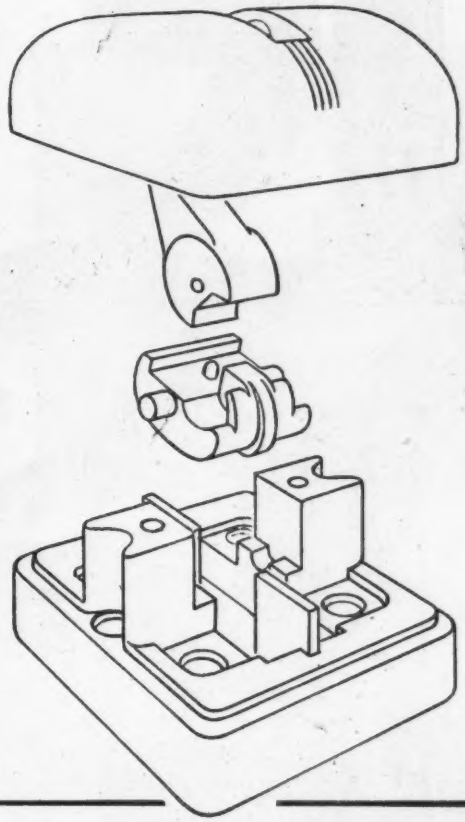
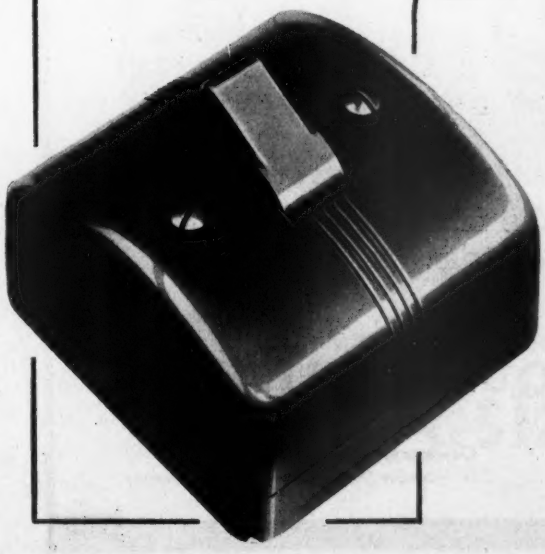
The World's Largest Manufacturers of Plastic Welding Equipment. Agents in principal countries throughout the world. Phone: VANDYKE 5691

Switch to success with Plastics

This 15 amp. double pole switch is composed of four moulded parts made from thermo-setting material. It is just one of the many technical moulding jobs — jobs calling for exacting precision — that Fraser & Glass have executed with success. Fraser & Glass are equipped with presses for practically every type of compression and injection moulding and are specialists in supplying technical mouldings for the electrical industry. Turn the light of over 25 years' experience on to your mouldings — switch to success with Fraser & Glass, Ltd., Woodside Lane, London, N.12 (Hillside 2224-5).

The Switch is illustrated by courtesy of A. P. Lundberg & Sons, Ltd., and is distributed by the various branches of Simplex Electric Co., Ltd.





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the plastics people

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Our modern factory is extensive, and equipped with the latest Plastic Fabricating Plant. It is self-contained, includes Tool Room, Technical and Experimental Departments, and employs Technicians and Designers.

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We are manufacturers of Plastic Components for all Government Departments and are approved by A.I.D. and Air Registration Board.

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Our field of activity covers the fabrication of all Plastic Materials—decorative and industrial.

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Something worth filing . . .

JUST RECENTLY we were asked by the Chatwood Safe Engineering Co., Ltd., to provide two plastic wheels for a new and revolutionary filing system. The wheels were to be moulded and spoked and both had to be twenty-one inches in diameter, one with a six inch wide flange and the other with an eight inch flange.

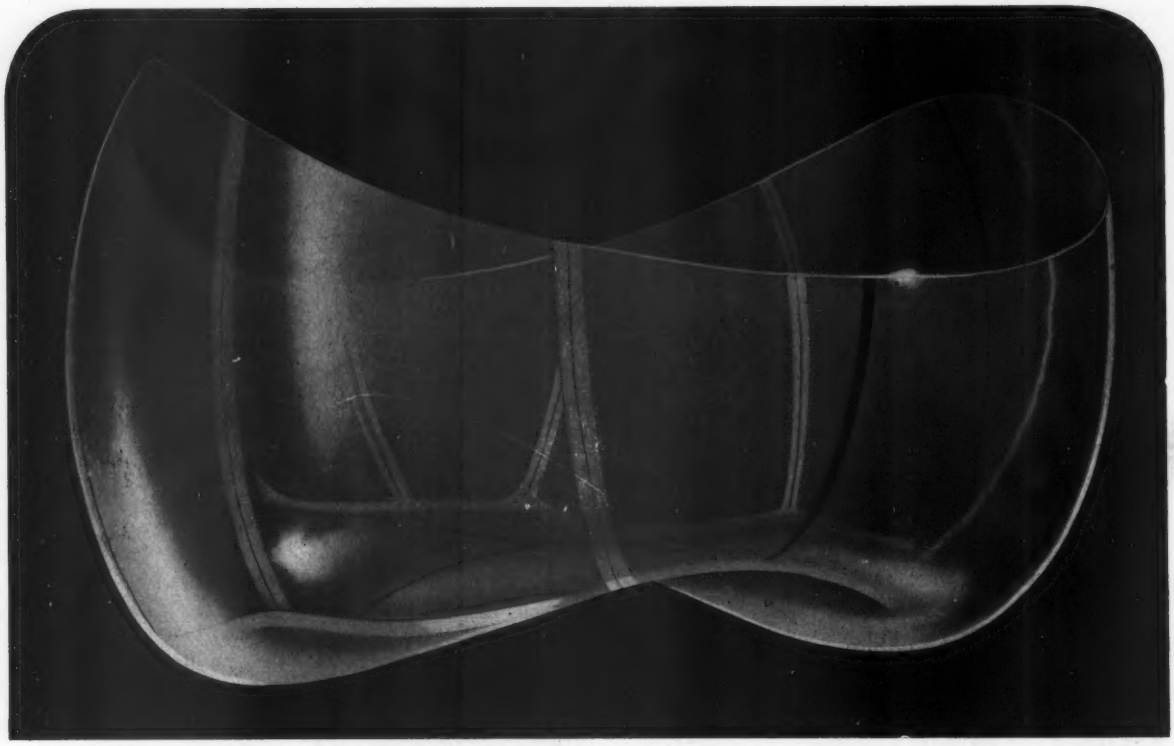
We made a composite tool to produce either half of either wheel by splitting the wheel through its circumference, so that the complete wheel required was obtained by taking two identical mouldings and reversing one to house into the other by means of moulded dowels, secured by fixing bolts. Each wheel weighed approximately nine pounds and was produced in general purpose material.

This is just one example of what we can do in meeting customers' requirements, no matter how complicated they may seem at first. We are always glad to co-operate on new designs—the tougher the better.

If you want to know what plastics can do for you —

ask Ashdowns

ASHDOWNS LIMITED, Eccleston Works, St. Helens, Lancs. Telephone : St. Helens 3206 *Ashdowns Ltd. is a subsidiary of Pilkington Brothers Ltd.*



RADOME *for* "LINCOLN" AIRCRAFT—OVERALL DIMENSIONS: 9' 6" x 6' 6" x 3' 3"

● *and NOW . . . . .* FIBRE-GLASS!

Having produced with complete success, the largest and most complicated components for the Aircraft Industry in "Perspex," *as illustrated above*, we are keeping abreast with progress and maintaining a service to industry with our new Fibre-Glass Department.

We are now producing radomes, panels, bulkheads, windows, etc., in laminated sheet, sandwich and honeycomb construction . . . the exceptional strength and electrical properties of these components are invaluable to the Aircraft Industry.

Our knowledge, technical advice and service are at your disposal at all times—do not hesitate to consult us. *Enquiries for home and export are welcomed.*

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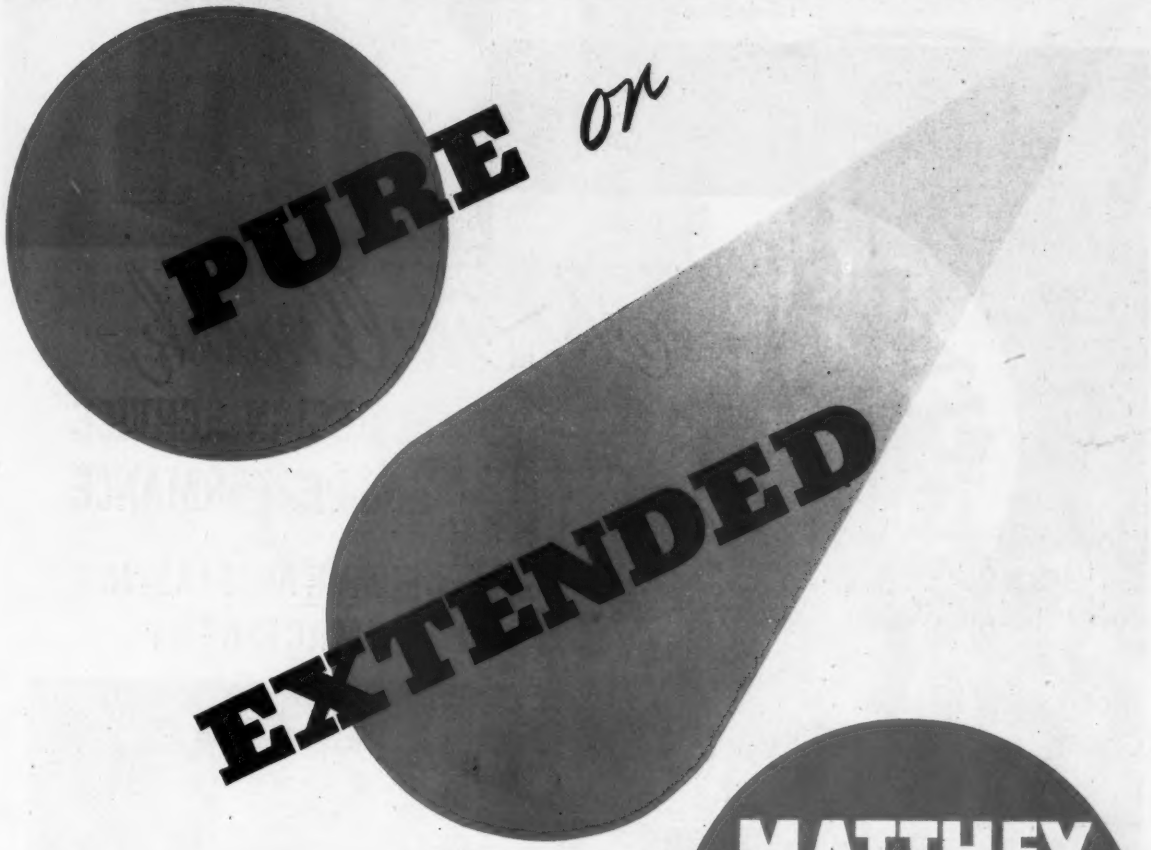


So varied in nature are the present-day forms and applications of plastic materials that the pigments they embody must show great powers of resistance to attack from both external and internal sources. Indeed, progress in the past has waited upon the provision of pigments having such all-round stability—in the development of Polyvinyl Chloride, for example, a plastic whose pigments must withstand exceptionally severe chemical and thermal effects during processing.

Matthey cadmium pigments, while eminently suitable for use in plastics of any type, possess in high degree the qualities needed to ensure successful pigmentation in this, undoubtedly the most exacting process to which a plastic colouring agent may be submitted.

MATTHEY CADMIUM PIGMENTS

One of the Specialised Products of

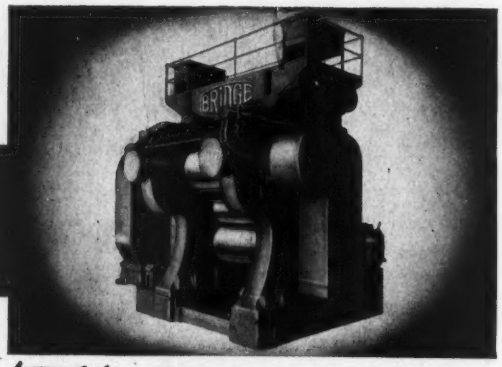
Johnson Matthey

Publications 313 *and* 1676 *deal fully with the subject, and we shall be glad to send you copies upon request. Please do not hesitate to write to us regarding any pigmentation problem you may encounter.*

JOHNSON, MATTHEY & CO., LIMITED · HATTON GARDEN · LONDON, E.C.1

GD 154

Precision Calender with three superimposed and one offset roller. Flood lubrication.



The Hallmark

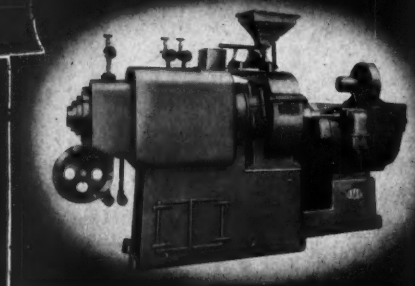
of DESIGN, SERVICE and PERFORMANCE *in* **RUBBER AND PLASTICS MACHINERY**

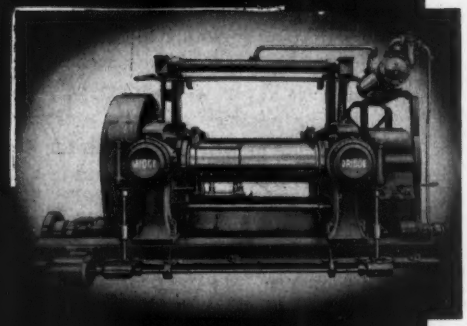
The Bridge — Banbury Patent Mixer. (1)

Precision Calender with four superimposed rollers. Flood lubrication. (2)

4½" Cold Feed Plastics Extruder. (3)

High temperature 22" x 60" Plastics Mill with flood lubrication. (4)





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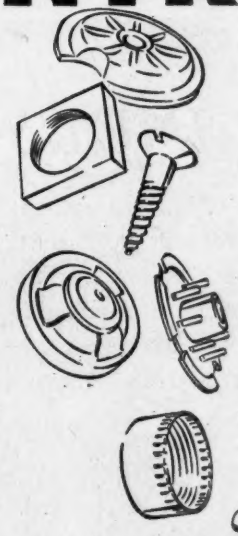

Small Part Feeders

Here is a new kind of feeder for small parts which provides automatic, oriented-position, single-line feeding, with rheostat control. Tapping machines, electronic counters and inspection devices, machine tools, centreless grinders, stamping and wrapping machines, capping presses, and a host of other units gain increased efficiency with Syntron controlled feeding.

Syntron 'Bowl' feeders handle parts made from almost all materials — metal, plastic, wood, glass, etc. Ideal for bolts, nuts, studs, washers, grommets, bottle caps, buttons, small pressed parts, etc., as well as tablets, wrapped sweets and similar food products. The rheostat control can be either built-in or separate.

Marketed for **INTERNATIONAL COMBUSTION LIMITED** *by*

RILEY STOKER COMPANY LIMITED

S19

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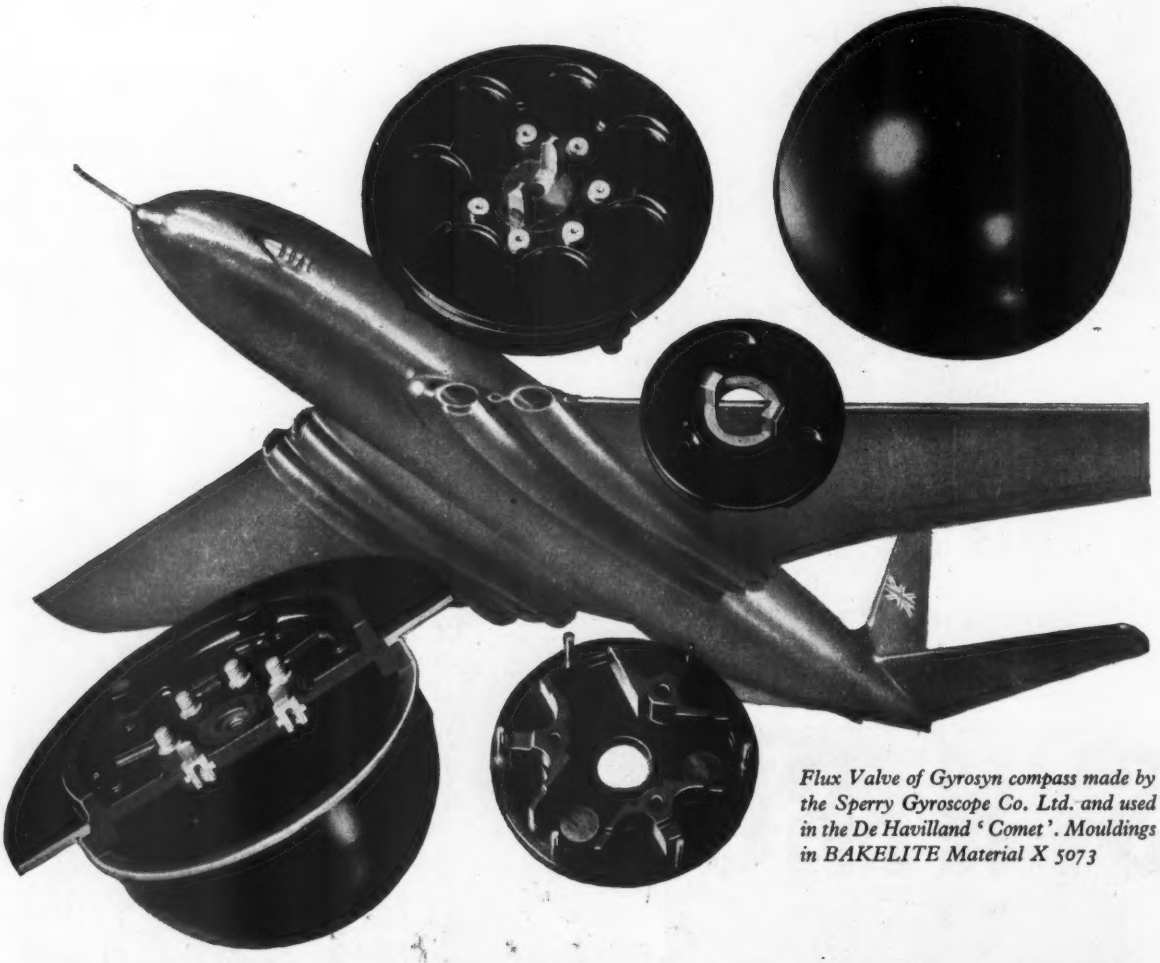
BAKELITE Materials give greater scope . . .



Flux Valve of Gyrosyn compass made by the Sperry Gyroscope Co. Ltd. and used in the De Havilland 'Comet'. Mouldings in BAKELITE Material X 5073

. . . when MOULDING FOR INDUSTRY

BAKELITE materials help to ensure the reliability of the new Gyrosyn aircraft compass. An essential in this gyro-magnetic instrument is the Flux Valve, built up from four mouldings — one being a terminal plate incorporating several beryllium-copper inserts. The complete Flux Valve assembly is hermetically sealed by another moulding, partially filled with oil and able to withstand 25 lbs/sq. in. pressure. Besides assuring the requisite strength, non-conductivity and resistance to oil, BAKELITE materials help reduce the weight of the Flux Valve to 1½ lbs.

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P20

Plastics

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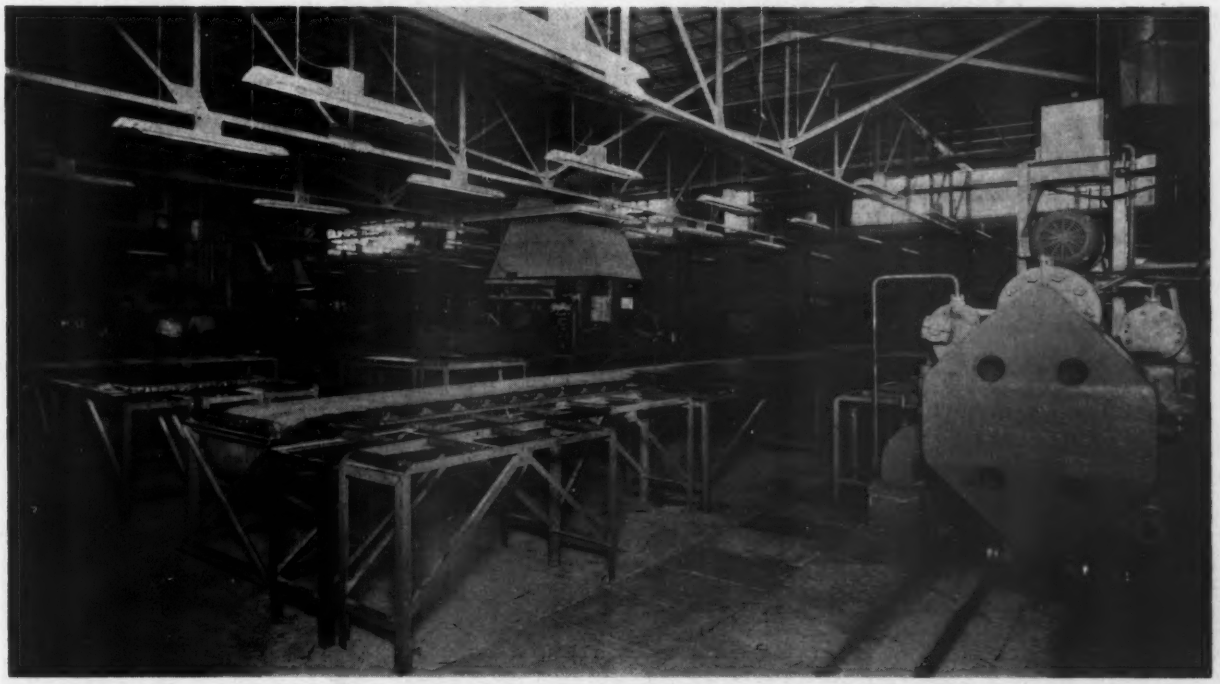
EDITOR: M. D. CURWEN B.Sc., A.R.I.C.

Published monthly in London, England.
Annual subscription rate 28/-. Shorter periods pro rata.

Press units used in the manufacture of "Holoplast" panels at the factory of Holoplast Ltd.



Photograph reproduced through the courtesy of Geo. Anson & Co. Ltd.

moulded plastics for the ANSON P.A.Y.E. recorder

This ingenious machine, which deals simply and accurately with the complexities of wages and income tax, is built on a one-piece moulding made from phenolic material.

The moulding is large and sturdy, dimensionally accurate, free from any applied finish and attractive in appearance. In fact — it is an excellent example of a good use for moulded plastics.

BM143

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Plastics

VOL. XVI. No. 162 JANUARY, 1951

" While we were speaking, we came to the border of a wood, new to us. The trees were of great height, and resembled the wild fig. Fritz remarked that out of one of the trunks there exuded a kind of resin, which hardened in the air. He took a little and kneaded it in his fingers. When he saw that it was softened and distended by the heat of his hands, so that he could fold without breaking it, astonished, he came to me crying, 'Really, father, I believe I have found gutta-percha' . . . 'Gutta-percha, as we have seen,' said I, 'falls drop by drop, from the trees. Being gathered in jars, and while in a liquid state, it is put into small earthern bottles, which are exposed to smoke, to dry the gum, and gives it a dark colour. Then the bottle which has served as a mould is broken and there remains a smooth flagon, glossy and flexible. . . . We shall fill a pair of stockings with sand, cover them with gutta-percha, and have a pair of boots, ready made, solid, and watertight.' "

Johann Rudolf Wyss, " Swiss Family Robinson, or the Adventures of a Father and his Four Sons on a Desert Island." 1813.

EDITORIALS

Lord McGowan

OVER 60 years ago Harry McGowan, of Glasgow, joined Nobel's Explosives, Ltd., at the age of 15. Last month Lord McGowan retired from the chairmanship of Imperial Chemical Industries, Ltd., the chemical colossus with a capital of over £85,000,000.

It was in 1925 that we first met him at the Ardeer works in Ayrshire (the company had by then changed its name to Nobel Industries, Ltd.), where we had gone to write the chemical story of " Safety Explosives." Harry McGowan had been knighted and he was managing director of the company. In 1926 the chemical world heard of the formation of Imperial Chemical Industries, Ltd., combining Nobel's, Brunner Mond, United Alkali and British Dyestuffs Corporation, a union of which Sir Alfred Mond (later Lord Melchett) and Sir Harry McGowan were the chief architects.

The time was a fateful one for Great Britain. Before the 1914-18 war the chemical-using industries of the world were under the hegemony of German manufacturing concerns, especially in the sphere of synthetic dyestuffs, although they had been first discovered and developed in England. With the help of the Key Industries Duties Act, which prohibited the import of dyestuffs and certain chemicals except under licence and the formation of I.C.I., the chemical industries of this country were able to talk with the great German companies on equal terms. We had gained a great place in the world of chemical industry at last.

To-day most readers know we are second in the world only to the U.S.A. in such production, and we are so primarily because of the work of these two great men. Lord Melchett died in 1930. Since that date Lord McGowan has held the reins of this great and ever-expanding concern, which has often led the world in chemical research, producing new dyes, new rubber chemicals, new fertilizers, petrol from coal, new disease and pest fighting products for humans and cattle, new plant hormones, new insecticides, new pigments, a host of heavy chemicals, synthetic resins and plastics and synthetic fibres.

With his retirement, Lord McGowan leaves a monument —many monuments—not only in Ardeer and Saltcoats, where he began, and in England in Billingham, Wilton, Welwyn and elsewhere, but farther afield in South Africa, Canada, India, Australia and in Brazil. His story is a main part of Great Britain's great economic history in the past 30 years.

The Art of Jointing

DURING the past 10 years it has scarcely been necessary to impress upon even the most casual reader of the rapid development of the larger injection moulding machine; and of its effect on the plastics industry as a whole. It is little more than 10-15 years ago that the ½- or 1-oz. machine was the only existing type in moulding-factories—it has not ceased to be a good stand-by in many to-day. In those days, cellulose acetate was the only general moulding powder and the machine produced a single small moulding or a number of very much smaller ones from the same mould, each more or less a finished unit in itself.

To-day the large machine, which resulted from the growing impetus to enter wider fields, produces single large mouldings, or a multiplicity of smaller ones; it is installed in most factories and is fed by an ever-increasing production of thermoplastics widened in range in physical and chemical properties. Indeed, when we talk of the inevitability in the increase in the use of thermoplastics, we can scarcely guess how really great must be their future. Not only has the range of materials increased beyond cellulose acetate to include cellulose acetobutyrate, polystyrene, polymethyl methacrylate, p.v.c., polythene and nylon (and we must note here for a variety of reasons that this does not mean that cellulose acetate has been superseded), but the user has the choice of a variety of characteristics in his raw material in varying hardness or softness, rigidity or flexibility, toughness, lightness, transparency or opacity in all colours, to say nothing of a variety of resistances to chemicals, solvents and so on.

Yet another important movement is afoot which deserves special comment. It is the introduction of the injection-moulding machine by industries which confine themselves to a very narrow range of manufactures they have long carried out in the older traditional materials, and see the economic and other advantages of employing plastics. Furthermore, there is the creation of the " new " industry with considerable knowledge of plastics and great engineering skill—again confining itself to a narrow range of products in which it is expert. We see in several such cases, following wisely slow and careful analysis, the deliberate tendency to oust the use of traditional materials almost entirely and to produce, so long as suitability of purpose is satisfied, complicated finished objects composed of a multiplicity of smaller plastic mouldings. Such multiplicity may be produced in multiple moulds

of large machines or in single moulds on smaller machine, but the point we wish to make is that all the mouldings are brought together in the same factory to be joined to produce the finished complex. Thus we believe we are seeing the expansion of cementing or otherwise jointing of thermoplastics which began with cellulose nitrate 60 or 70 years ago, on a much larger scale than has ever been seen before.

To many, such a process which entails further complications of added space where little or none is available, more labour of a different type and new technique which may or may not be known, is regarded with considerable disfavour, and as being unsupportably disturbing to what may be a purely engineering "set-up." Nevertheless, since the growth is of considerable importance and the technique is spreading it has been pointed out to us that those who may be considering such work and who know little of what it entails will be saved many headaches if the whole subject were considered in detail in this journal.

This matter of jointing thermoplastics may be basically simple, but its expansion to factory scale work is by no means so, for it goes far beyond the mere provision of a bottle of solvent or cement to a worker. A knowledge of the industrial hazards of each material used is as imperative as is a knowledge of their choice and chemical and physical properties. As a result, it is imperative to be thoroughly acquainted with the Home Office Regulations concerning their storage and use—the means of application, the need for removal of solvent vapours at the point of application. Again it is urgent to study the means possible for preventing too rapid volatilization—which in view of the general impossibility of recovering solvent in small plants can prove expensive.

On the purely physical side of application there is much to know also, although this aspect and the use and design of clamps or jigs present little difficulty to the engineer.

The problem considered as a whole is worth close analysis, especially for those who propose entering the field. We hope, therefore, to publish in the near future as complete a picture of it as we can.

Moulding Powder and Shot

They say in toy-manufacturing circles, as in most aspects of human endeavours, that there's nothing new under the sun. I remember remarking to one manufacturer that a certain toy seemed very novel, only to be answered with a snort and "My father brought it over from Germany (or perhaps it was Japan) in 1864." Anyhow, I am willing to bet that in one respect at least the toy figure I have in front of me on my desk is absolutely new and brilliant in conception. Jopo, this toy figure, is made out of p.v.c. covered wire, the brightness of the idea being the realization that the material can be twisted or bent and "stay put." Obviously, wire itself would do, but covered with p.v.c. makes all the difference. Furthermore, the structure is not only of wire but is moulded also into additions of p.v.c. (e.g., for the hat, head and feet). This idea originated in Germany or France or Czechoslovakia, or even points east, but wherever its birthplace it deserves some sort of prize. Legs and arms can be twisted into all sorts of postures, so that it is the finest method of teaching children something about centre of gravity. Mr. MacDonald Watson, who looks after publicity for BX Plastics, Ltd., the suppliers of the special p.v.c. for the job, first told me about it. Ebonestos Industries, Ltd., do the moulding by a rather elaborate and difficult process, for Messrs. Kinver and Radov.

Jopo

* * *

I have been reading with considerable interest and gain Mr. Freund's new book on "Plastics Moulding Engineering," which has just been published by Pitmans. In his preface the author apologizes for the "readability" of the text and the fact that the style is not so elegant as that to which the reader used to scientific and technical books may be accustomed. "My excuse," he writes, "is a phrase which I remember from my student's days quoting the mathematician Leibnitz: 'We technicians regard elegance as a matter for shoemakers and tailors.'" I should have thought this decrying of these two producers of very functional equipment a sad lapse by the great philosopher in an unguarded moment. Moreover I have always regarded mathematics as the most elegant of the sciences. Certainly Mr. Freund's method of estimating press costs on pp. 18-20 of his book bears the hall-mark of great elegance. And since he will not mind a gentle leg-pulling, I would remind Mr. Freund that I have never spelt the name other than Leibniz. Neither, indeed, did Leibniz himself, and for confirmation please read *Die Werke von Leibniz*, ed. Onno Klopp, Hanover, 1864, vol. I, p. XXIV!

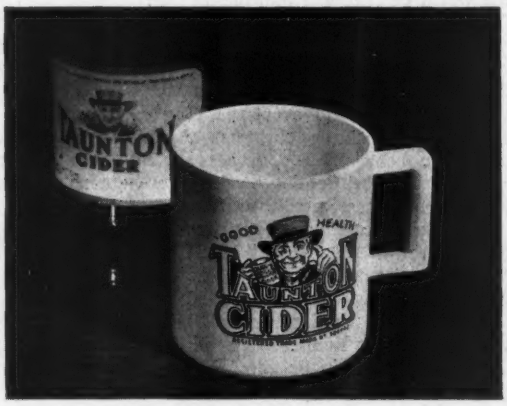
Philological exercise

* * *

Many readers will remember the sad tale I unfolded in May last of the life and dangling death of one Samuel Hall, who, in a moment of dire insult, bashed a neighbouring bean with a pewter can, from which he had been absorbing sustenance in peace and with earnestness as any sailor should. They will also remember I put forward the startling theory of Sam's basic innocence, in that it was possible, nay probable, that the possessor of the damaged bean may have died from lead poisoning. To-day I have good news for other matelots who may wish to defend their honour. Mervyn Jude, of British Industrial Plastics, Ltd., sends me the accompanying picture and the information that the Taunton Cider Co., Ltd., are now issuing to their customers drinking mugs moulded from Beetle plastic material, thus making the world a safe place for democrats to drink in. They are moulded by Insulation Manufacturing Co. (Plastics), Ltd., of Glastonbury, Somerset. I am approaching the two Zummerzet firms and B.I.P. to accept honorary membership of my new organization—the Plastics Society for the Prevention of Cruelty to Sailors.

P.S.P. C.S.

DOGSBODDY.



Synthetic Resin Adhesives for Metal Bonding

By C. J. MOSS, B.Sc.*

THE gluing of wood and similar porous materials is an art which has been practised for many centuries, but it is only during the last 20 years that significant advances have been made in the qualities of the glues used. Not only have synthetic adhesives been made which will withstand prolonged exposure to the attack of mould growths and to immersion in water, but also special glues have been developed which possess these properties even when used in gluing wooden components whose design is such that it is not possible to apply pressure during the setting of the glue. Such cements, known in the wood-working industries as "gap-filling" glues, will, without any clamping pressure, make joints between hard woods which are usually stronger than the wood itself.

Although, therefore, glues for wood have been used at least since the time of the Pharaohs in Ancient Egypt, it is only recently that adhesives possessing the remarkable properties mentioned above have become available. The development of strong glues for metals is even more recent.

The bonding of metals to give joints of high mechanical efficiency is a difficult problem to solve for the following reasons:—

(1) Metals are not porous, and, therefore, glues containing solvents are unlikely to be satisfactory except for very small joints. If solvent is trapped in a joint, it will be unable to escape through the metal and will cause poor adhesion.

(2) For the same reason any glue used must neither give off any volatile by-products in hardening, nor must it require any products from outside the joint.

(3) Since the use of solvents is not advisable, it is difficult to apply the adhesive to the metal in such a way that the metal is "wetted." Evidently, if the adhesive does not "wet" the metal there is no possibility of obtaining adhesion.

(4) Because the metals in common use are relatively strong materials and adhesives for them should also be strong both in their own cohesive strength as well as in their strength of adhesion.

(5) When metals are loaded beyond their yield point they stretch very rapidly. Elongations of the order of 25 per cent. are not in the least uncommon and many metals are far more ductile. Therefore, if joints which will develop a high mechanical efficiency are to be made between metals, the jointing material used must be capable of withstanding very severe strains before breakdown occurs.

(6) The adhesives must not corrode metals.

Although it is not difficult to put forward a list of conditions which must be satisfied if good bonds are to be made between metals, it is much more difficult to give any explanation of the nature of adhesion. This appears to be a little-understood subject and about the most that can be said is that, since satisfacory bonds can be made between highly polished surfaces (i.e., where no mechanical interlocking is possible), then adhesion must be the result of intermolecular forces.

Many materials when applied to metals as surface coatings show good adhesion but are quite unsatisfactory for use as cements. Good examples are the linseed and similar oils which form the basis of traditional paints. They adhere well to metals and are quite ductile, but they not only lack strength but also require atmospheric oxygen for hardening. The urea-

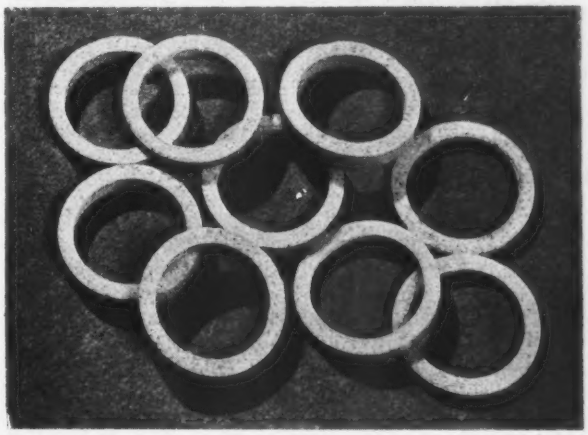


Fig. 3 (above).—Rings of "Araldite" made in a pelleting machine from a mixture of "Araldite" natural powder with 1 per cent. stearic acid. Pellets and rings of this kind are useful when "Araldite" is required for the production of large numbers of components.

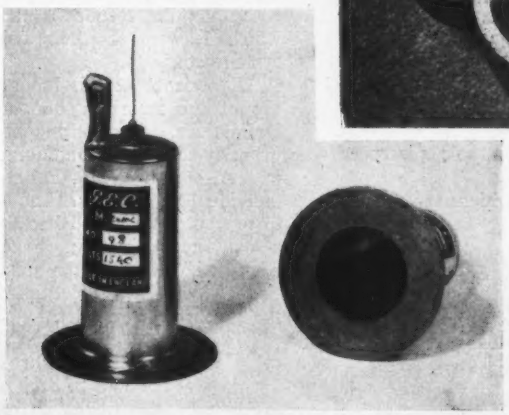


Fig. 1 (right).—In this Geiger Muller counter, made by the General Electric Co., Ltd., "Araldite" is used for sealing the mica end to the metal body.

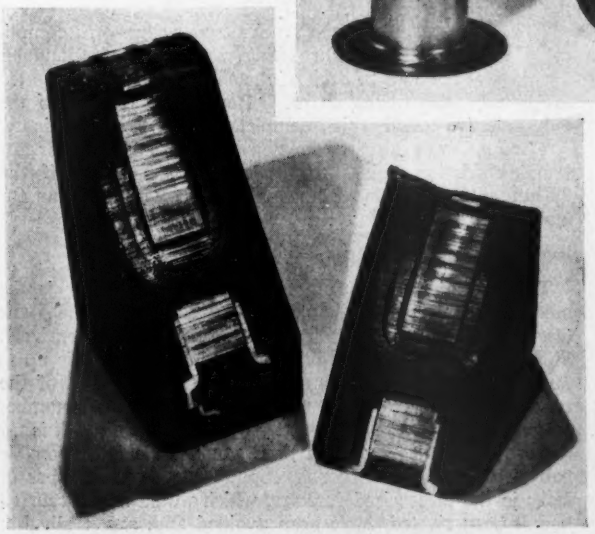


Fig. 2.—Transformer cast in "Araldite" and subsequently sawn in half to show the excellent penetration of the resin. (Courtesy, Mullard Equipment Ltd.)

* Project Engineer, Aero Research, Ltd., Duxford, Cambridge.

formaldehyde resins used with so much success for wood gluing provide another example. These are cheap, set quickly at room temperature, and can be made to fill gaps up to $\frac{1}{16}$ in. in thickness. Unfortunately, however, they are applied as solutions in water and evolve more water during their hardening which would be unable to escape from the joint. In addition, when fully cured, the resin is an extremely brittle solid which would disintegrate as soon as the metal took up any appreciable strain.

Pre-treatment of Metals

Before discussing the glues which have been developed recently for the bonding of metal, it is desirable to consider the pre-treatment of the metal itself. As might be expected, even traces of grease result in inferior or unsatisfactory wetting of the metal and consequently some thoroughly reliable method of degreasing is essential. Trichlorethylene vapour baths have been used for this purpose for many years and have given satisfactory results. In addition to degreasing it is important to remove any corrosion from the metal surfaces. For example, steel which is rusty or covered with scale, or light alloys which are corroded, may be sand-blasted, wire-brushed or rubbed vigorously with emery. Chemical cleaning agents may also be used; the mixture of chromic and sulphuric acids specified in D.T.D. 915 is known to provide a suitable method for "pickling" aluminium alloys.

Glued Joints for a "Synchrotron"

The first successful glue for metals ("Redux") was developed during 1941 by Aero Research, Ltd. This glue consists of a liquid resin which is used to "wet" the metal surfaces, and a white powder which gives the joint considerable toughness and ductility. The two constituents taken together satisfy all the conditions which we have proposed for metal glues. The resin is brushed on the degreased and cleaned metal surfaces, the powder sprinkled on top of it and then the components are clamped together with a pressure of 100-200 lb./sq. in. and stoved at 140-150 degrees C. for 20 minutes. This was the glue used so successfully in making the insulating and vacuum-tight joints of the laminated pole pieces of the synchrotron at Berkeley, California[1].

The synchrotron is a piece of equipment designed to accelerate electrons by means of repeated applications of comparatively moderate voltages and thus avoids the need for voltages running into hundreds of millions. The following quotations are from the report of the University of California describing the results of their experiments with "Redux" which led up to their using this metal glue on their synchrotron:—

"Experience at this laboratory has been confined to the use of the resin for bonding electrical grade silicon steel laminations. Very strong bonds have been obtained under properly controlled conditions. The bond strength is sufficient to tear 29 gauge (.014 in.) steel when attempting to peel off individual laminations. The bond is sufficiently homogeneous to prevent leaks parallel to the plane of the laminations into a high vacuum system. Experiments at this laboratory have been designed to test the adhesive for use in bonding laminations which form pole tips and vacuum chamber lids for the synchrotron magnet.

"The manufacture of the synchrotron wedges was complicated by the necessity for filling a number of triangular openings at the ends of each of the short laminations inserted to produce the wedge shape. 'Redux' proved to be the only adhesive tested which completely filled these openings."

"Redux" was also used extensively during the war for bonding friction linings to the steel clutch plates of the "Churchill" tank, and both during and since the war for making aircraft structures.

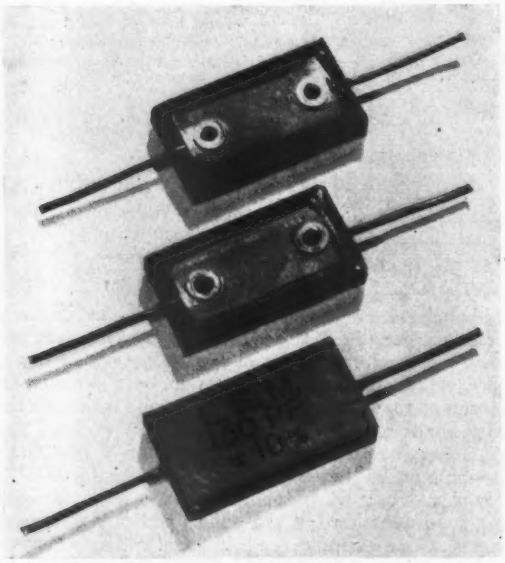


Fig. 4.—Silvered mica condensers encased in "Araldite" casting resin. The "Araldite" provides an excellent seal against tropical conditions, and is also a good insulating material. (Courtesy, London Electrical Manufacturing Co., Ltd.)

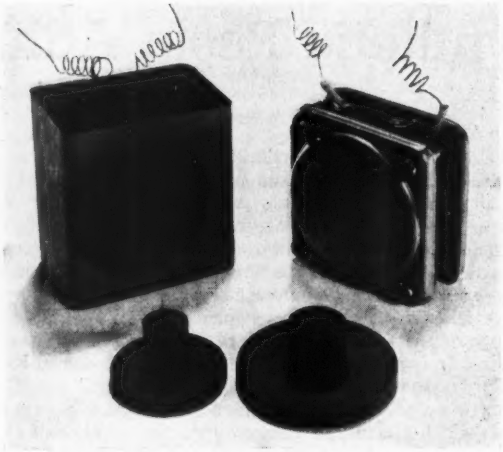


Fig. 5.—This photograph shows the use of "Araldite" powder for bonding parts of "Ferroxcube" (lower part of photograph), which are employed for the core of a coil subsequently encased in "Araldite" casting resin (top left-hand corner). A core made by the normal assembly method is also shown (top right-hand corner). "Ferroxcube" is a non-metallic magnetic material developed by Mullard Equipment Ltd. for use in transformers, etc.

Construction of Jet-propelled Aircraft

The de Havilland "Comet" jet-propelled airliner is the most recent aircraft to employ "Redux," and it is also the aircraft in which metal gluing has been used most extensively. Stiffeners are bonded to wing and fuselage skin panels up to 30 ft. in length, whilst the spherical dome at the end of the pressurized fuselage is built up by bonding together a number of segments. The result is that the skin of the aircraft is far more aerodynamically clean than would have been possible had it been of riveted construction, that a large number of leaks in the pressurized fuselage, which would have occurred had it been riveted, have been avoided and, above all, that because of the superior strength of the glued joints considerable savings in structure weight have been made. Some indication of the extent of this weight saving is possible from

the results of some tests carried out by the Gloster Aircraft Co., which showed that panels of "Redux"-bonded construction carried a load about 40 per cent. greater than similar riveted ones. Many other applications have been found for the "Redux" process, and descriptions of them may be found in the journals given in the bibliography at the end of this article.[5, 6, 7, 8, 9, 10]

Bonding Rubber to Metal

A recent development of the "Redux" process has been for the bonding of rubber to metal. Hitherto this has been carried out by brass-plating the metal, a process which is fairly expensive and which requires close control followed by vulcanizing the rubber "in situ." Since it is difficult to brass-plate many metals, the process has in practice been mainly restricted to bonding rubber to mild steel. By means of "Redux," however, vulcanized natural or synthetic rubbers may be bonded to light alloys, stainless steel, cast iron, etc. Natural rubbers are first treated by immersing them for a few minutes in concentrated sulphuric acid (synthetic rubbers are treated with concentrated nitric acid instead), followed by washing, drying, and application of the "Redux" adhesive. The glue is normally cured in 20 minutes at 140-150 degrees C., but rather lower pressures than the 100-200 lb./sq. in. used in metal bonding have been found satisfactory. For rubbers which will not withstand the bonding temperature required for curing "Redux," a modification of the glue may be used which will give good bonds in 20 minutes at 110-120 degrees C. with a pressure of about 20 lb./sq. in.

"Araldite" Bonding

A feature of the glueing process for metals which we have already described is that pressure is required to produce good bonds. Recently, an entirely new resin has been developed by Ciba, Ltd., Basle, Switzerland, which gives remarkably good adhesion to metals, quartz, mica, porcelain, etc., with only very light clamping; in fact, just sufficient to maintain the parts in contact. It is known by chemists as an epoxy-ethane resin and it satisfies one of the most important conditions for a glue for metals because it polymerizes without giving off any volatile by-products.

Another unusual property of this resin is that it is applied to the metal as a "hot melt." That is to say, the metal is heated to about 100-120 degrees C. and the resin applied as a powder or as a rod. When it makes contact with the metal, it melts and then adheres, but at this stage it is very brittle and violent handling would cause it to flake off. Alternatively, the resin powder may be sprayed on the cold metal by means of a "Schori" flame-spraying gun. The resin is then cured by stoving it at 180 degrees C. for one-two hours, or for time and temperature given in Table 1. During stoving the resin

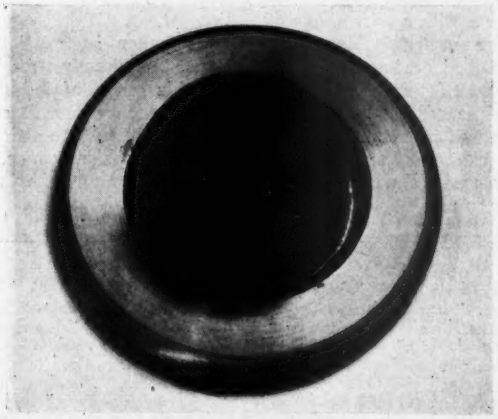


Fig. 6.—High-voltage insulator made by bonding a sand-filled "Araldite" casting to a brass base. The adhesive used is "Araldite" type 3. (Courtesy, Metropolitan-Vickers Electrical Co., Ltd.)

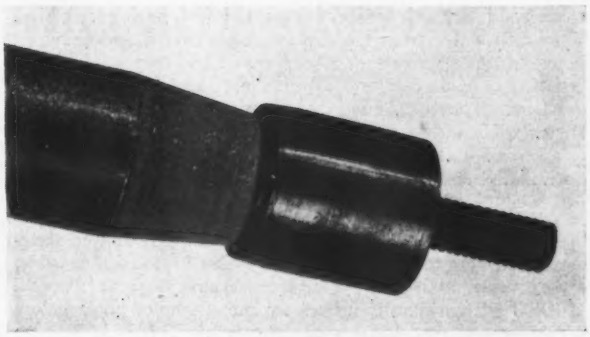


Fig. 7.—Metal ferrules bonded with "Araldite" to a "Mycalex" insulator rod used for high-voltage apparatus. (Courtesy, Metropolitan-Vickers Electrical Co., Ltd.)

first melts and then, as polymerization proceeds, it increases in viscosity and finally solidifies; polymerization continues for some time after the solid state is reached, but it is accompanied by only a very slight shrinkage in volume.

Besides the methods described above, "Araldite" may be applied in yet another way, which is particularly useful when large numbers of small components are required. After mixing 1 per cent. of stearic acid with "Araldite" natural powder, it may be formed into pellets in one of the machines used for this purpose. These pellets frequently provide a convenient way of handling the adhesive, and have the advantage that they obviate the need for heating the metal to the melting point of the resin before applying it.

Table 1.—Setting Times and Temperatures for "Araldite" Type I.

Temperature °C.	Time		
	Minimum	Optimum	Maximum
240	10 min.	20 min.	60 min.
220	20 min.	40 min.	100 min.
200	40 min.	1 hr.	5 hr.
180	1 hr.	3 hr.	15 hr.
160	3 hr.	8 hr.	40 hr.
140	7 hr.	24 hr.	—
130	15 hr.	36 hr.	—

Glued joints made with "Araldite" will withstand prolonged immersion in water and common solvents, but some loss in strength is experienced after one month in boiling water. The shear strength is maintained up to about 100 degrees C., when it drops off fairly sharply.

A property of "Araldite" which is sometimes overlooked is its rather high coefficient of thermal expansion, i.e., about 60×10^{-6} per degrees C. It is about five times that of steel and many more times that of quartz and porcelain, but it is only of importance if very thick glued joints are made. Then it is desirable to add an inert filler (such as French chalk), which sharply reduces its coefficient of thermal expansion. A far more important consideration is the difference in the thermal coefficients of metals and quartz, porcelain and similar materials, which may sometimes cause serious difficulties when they are to be joined together by a glue which sets hard at elevated temperature.

The "Araldite" is usually cured at temperatures of 180 degrees C. or higher, but when dealing with combinations having widely different expansion and contraction rates it is far wiser to stove the resin at a temperature of 140-150 degrees C., even though the time must be increased to about 8 hours. The assembly should then be cooled slowly to the laboratory temperature.

Cold Setting "Araldite" Adhesives

Because of the difficulties described above it is interesting to know that cold setting forms of the "Araldite" adhesive have now been developed. They all require mixing with a hardener and will then set in about 24 hours at room temperature, but it is important to appreciate that they do not possess

such good strength properties as the hot setting adhesive. They also suffer from the disadvantages that they weaken at temperatures above about 50 degrees C. and they are not very resistant to some common solvents, e.g., acetone and trichlorethylene. They are, however, surprisingly resistant to some strong acids and to petrol and lubricating oils.

These cold setting adhesives are finding many uses where outstanding strength properties are not important.

Strength of Glued Joints

Unfortunately it is not possible to make any simple statement regarding the strength of glued joints.[2] It is not possible, for example, to say that glued joints have a shear strength of 8,800 lb./sq. in., although from the examples given below it will be seen that this is sometimes true. This is so because the strength depends upon so many factors. In pure tension, joints made with "Araldite" or "Redux" usually have a failing load of about 5,000 lb./sq. in., but if there is any tendency for bending to be superimposed on the tension a sharp fall in breaking load occurs. In pure shear uniformly distributed over a glued area the failing load is about 10,000 lb./sq. in., but in practice it is rare for such loading to occur.

When overlap joints are made by gluing together strips of metal they are normally tested by applying loads to the ends of the metal strips. Since they are always offset a little from the glue line, a small bending moment as well as a shear load is applied to the joint and this decreases the load which can be supported before failure occurs. Much more serious, however, are the stress concentrations which occur at the ends of the joint. They are caused by the differential rates of straining of the parts of metal in contact with the glue due to the transfer of the load from one piece of metal to the other. The result of these stress concentrations is to decrease the average breaking load of the joint to a value less than is obtained when it is tested in pure shear. This behaviour is best illustrated by a number of examples.

If overlap joints are made between strips of 20 s.w.g. aluminium alloy to specification D.T.D. 546, the failing load will be about 2,200 lb. for an overlap of ¼-in., but it would be only about 2,500 lb. if the overlap were increased to ½-in., i.e., the average failing stress will fall from 8,800 lb./sq. in. to 5,000 lb./sq. in when the overlap is increased from ¼-in. to ½-in. If the thickness of the metal were increased from 20 s.w.g. to 16 s.w.g. the average failing stress for the ½-in. overlap joint would increase from 5,000 lb./sq. in. to about 6,400 lb./sq. in. If a harder alloy were used, still higher strengths may be expected, whereas with a softer metal, such as aluminium itself, considerably lower average failing stresses would be obtained. Steel of similar mechanical properties to the aluminium alloys will give glued joints of similar strengths, but if brass of equal strength were used the results would be a good deal lower.

Fig. 8.—Magnesium alloy castings may be dipped in "Araldite" surface-coating resin and then stoved to protect them from corrosion. (Courtesy, Gittings and Hills, Ltd.)

In general, glues such as "Redux" and "Araldite" give best results with steel and aluminium alloys, and not quite such good results with other metals. That surface treatment also affects the results is illustrated by the lower strengths obtainable with anodized aluminium alloys than with the metal which has been chemically cleaned, and by the poor results obtained with steels which have been treated in one of the phosphate dips which are often used to prevent corrosion.

These conclusions may be summarized as follows. When tested in shear, the average failing loads of glued joints vary approximately in inverse proportion to the length of the joint, but they increase in proportion to its width. For thin sheets they increase roughly in proportion to the square root of the thickness of the metal, but evidently a limit is set to such an increase by the strength of the glue itself. Another interesting result is that within this limit the strength of the joint increases in proportion to the yield point of the metal tested. Finally, adhesion is not equally good to all metals, being best for well-cleaned aluminium alloys and steels.

"Araldite" Surface Coating and Casting Resins

Although the usual surface coatings do not make satisfactory adhesives for non-porous materials, it is sometimes true that a material with good adhesive properties may be dissolved in suitable solvents and used as a surface coating. Thus a slightly modified form of the "Araldite" resin may be used as a surface coating, particularly where advantage can be taken of its excellent adhesive properties.[3] A good example is the protection of magnesium castings from corrosion since the usual paints do not adhere well to this metal and its alloys, but tests have already shown that "Araldite" 985 does so satisfactorily. Because this coating also has a good resistance to chemical attack it provides a good means of preventing corrosion of the castings.

Another interesting use of the "Araldite" or epoxy-ethane resins, which depends upon their remarkable adhesion to a wide range of materials, is as casting resins. A form of "Araldite" has been developed which, after melting and mixing with a powder hardener, may be cast round transformers, condensers, etc., so as to seal them against external conditions.[4] Clearly without good adhesion between the resin and the embedded component and its connecting wires, there would always be capillaries through which moisture could penetrate to the parts which it is desired to protect. There is no doubt that the "Araldite" adheres well, and fortunately it also possesses good electrical properties and thus is suitable for use with a wide range of equipment.

The materials described in this paper have all been developed during the past few years, but already they have proved of remarkable value in a wide range of industries. The use of the "Redux" process in bonding aircraft structures and of "Araldite" in the electrical industries, to give only two examples, are already of considerable significance, but they are likely to become of far greater importance in the near future.

REFERENCES

(1) *Physics in* 1946, "*Applied Physics*," 1947/*Feb.*/140. **(2)** *Strength of Glued Joints*, "*Aircraft Engineer*," 1944/**16**/115 *and* 140. **(3)** *Araldite Surface Coating Resin 985E for the Protection of Metal Surfaces*, "*Aero Research Technical Notes*," *Bulletin No.* 75 (*March*, 1949). **(4)** *Araldite—A New Plastic with Excellent Electrical and Mechanical Properties*, "*Electronic Engineering*," 1949/*Oct.*/389. **(5)** *Bonding by Redux*, "*Aeroplane*," 1946/*Sept.* 20/329. **(6)** *Facia Panel Manufacture*, "*Automobile Engineer*,"1949/*Apr.*/164. **(7)** *Accurate Wing Contours*, "*Aircraft Production*," 1949/*June*/198. **(8)** *Metal Bonding*, "*Metal Industry*," 1949/*Aug.* 12/123 *and* 132. **(9)** *Araldite—A New Bonding Resin*, "*Sheet Metal Industry*," 1949/*Sept.*/1987. **(10)** *Synthetic Resins—Applications in the Engineering Industries*, "*Metal Industry*," 1950/*Feb.* 24/143 *and* 1950/*Mar.*3/171.

World's Industry Employs Plastics

GENERAL ENGINEERING

Nylon piston resists abrasion in a multi-purpose pump. The eccentric piston machined from moulded nylon maintains high pressure and volume without lubrication. ("Product Engineering," 1950/Sep./103.)

Bearings and gears of plastics.—H. Zickel reviews the present development of plastic bearings and gears for general engineering purposes, and provides diagrams for their loading capacity. ("Industrie-Anzeiger," Essen, 1950/Oct./4.)

Mechanical properties of plastics.—A three-day conference on this subject attracted more than 200 scientists and engineers to the Massachusetts Institute of Technology in June, 1950. A short report on the papers is given. ("Materials and Methods," 1950/Aug./120.)

Injection moulding machine.—In the new machine of Fellows Gear Shaper Co. the plastic material is sub-divided into small cross-sections or streams for better heat transfer. Dwelling or hanging-up of the material in the heating cylinder is prevented by close contact between separator and cylinder wall. ("Machine Design," 1950/Aug./131.)

Plastic cylinder fabricator.—Transparent thermoplastic cylinders are automatically sized for diameter and the joint sealed in the machine produced by Taber Instrument Corp. ("Machine Design," 1950/Aug./132.)

Working thermoplastics.—K. Stoeckhert reviews the machines for the working of thermoplastics which are now available in Germany. Kneading machines are produced by one firm only, eight firms produce roller-type mixing machines and calenders, injection-moulding machines are produced by 10 firms, and extrusion presses with worm feed by nine firms. ("Kunststoffe," 1950/June/195.)

Hot-gas welding of thermoplastics.—The applied technique is described in detail. Pressure is 5 to 15 lb./sq. in. Nozzle temperature 500 to 600 degrees F., and welding temperature 375 to 425 degrees F. Application: Fabricating vats, buckets, jugs, pipelines, fume ducts, etc. ("Welding Engineer," 1950/Sep./35.)

Low-cost finishing of plastics consists of throwing non-abrading pellets, such as crushed apricot stones, by means of a high-speed rotating blade against surface of plastic parts. ("Electrical Manufacturing," 1950/Aug./120.)

Circular grinder.—New small grinder for dry grinding of all types of plastics, rubber and flexible materials, such as p.v.c. The workpiece is held stationary between points and the grinding head stock traverses. ("Technik and Handwerk," 1950/Sep./209.)

CHEMICAL

Trifluorochloroethylene is now being manufactured in Great Britain in the form of granules. This interesting article deals with the development of dispersions for protective coatings. ("Chemical Age," 1950/Nov. 18/715.)

Cast resins for process equipment.—"Kemplas" modified phenolic resins are said to be lighter and stronger than construction material hitherto used. Resistant to corrosion, they can withstand temperatures up to 350 degrees F. Cast pieces can be readily machined and threaded. ("Chem. Eng. Prog.," 1950/Oct./20.)

Plastics in gas, water shut-offs.—Plastics have been used by the oil industry for shut-offs since 1940. Formation temperature generally 70-300 degrees F. This describes the application of plastics and the technique followed in completion of two jobs. ("World Oil," 1950/March/108.)

Saran-lined diaphragm valves are made in sizes from 1 in. to 6 ins. and can handle corrosive fluids and gases. ("Materials and Methods," Vol. 32, 1950/Oct./96.)

MISCELLANEOUS

Moulded plastic boats from 8-ft. to 24-ft. size are mass-produced by an improved technique. A 24-ft. cruiser can be turned out in a day, compared with four to six weeks when wood or metal is used. ("Business Week," 1950/Sep./52.)

Nylon teasel brushes have been introduced in two woollen mills with excellent results. Expected life is two years of continuous service without repair. ("Textile World," 1950/Sep./125.)

Extruded polyethylene rings are produced by an improved technique. Rings are used to insulate the outer edge of television tubes. ("Product Engineering," 1950/Sep./170.)

More plastics in refrigerators.—The new Crosley refrigerator (Avco Mfg. Corp., Cincinatti, Ohio) uses a total of 24 lb. of plastic in 68 different parts. ("Product Engineering," 1950/Sep./98.)

Wall coverings and window panes of polystyrene.—H. Turnwald describes a new design for fixing large plates to walls. Similar plates of transparent or coloured polystyrole can be used as window panes. ("Kunststoffe," 1950/July/216-218.)

Polyamide tapes.—A. Mueller reviews this material ("Igamid B") with reference to its general properties, methods of treatment and applications. ("Kunststoffe," 1950/Aug./241.)

Glueing wood to metal.—E. J. Ritter discusses the techniques of glueing wood veneers to metal sheets by means of "Tegofilm F Z." ("Kunststoffe," 1950/Aug./255.)

High-molecular fluorine compounds.—W. Graulich describes the constitution and treatment of these materials which, as polytetrafluorethylene ("Teflon" or "Fluon") and poly-trifluorchlorethylene ("Kel-F"), are produced commercially in the U.S.A. Technical development is said to be based on German investigations. ("Kunststoffe," 1950/Aug./258.)

Compounding vinyls.—C. J. Scanlan describes a special process for compounding vinyl plastics whereby no plasticizer is used. The material produced is said to have greater elasticity and longer life. ("Wire and Wire Products," 1950/Sep./733.)

Endurance tests.—Description of a new testing machine with loading cycles of 1,500 and 3,000 cycles per min. for testing plastic bars in bending and torsion. ("Industrie Anzeiger" (Essen), 1950/Oct. 31/10.)

Plastic tower.—A 30-ft.-high plastic tower weighing 300 lb., believed to be the largest ever built, is used to test the performance of radio and radar antennæ mounted flush with the aircraft skin. Plastics were used to avoid interference to radio wave transmission. ("Product Engineering," 1950/Aug./158.)

Bio-plastic mounts.—Vinylite injections of the vascular system of animals and organs, from which the tissue has been removed, allow the student to observe the relationship of the vessels. ("Ward's Natural Science Bulletin," 1950/Sep./3.)

Silicone-coated acrylic fabric, "Cohrlastic," is made from the du Pont fabric "Orlon." Impermeability, heat and cold resistance, good dielectric strength and high tensile strength make an excellent diaphragm material, but other industrial applications are indicated. Producer: Connecticut Hard Rubber Co., 407, East Street, New Haven, 9, Conn. ("Materials and Methods," 1950/Oct./96.)

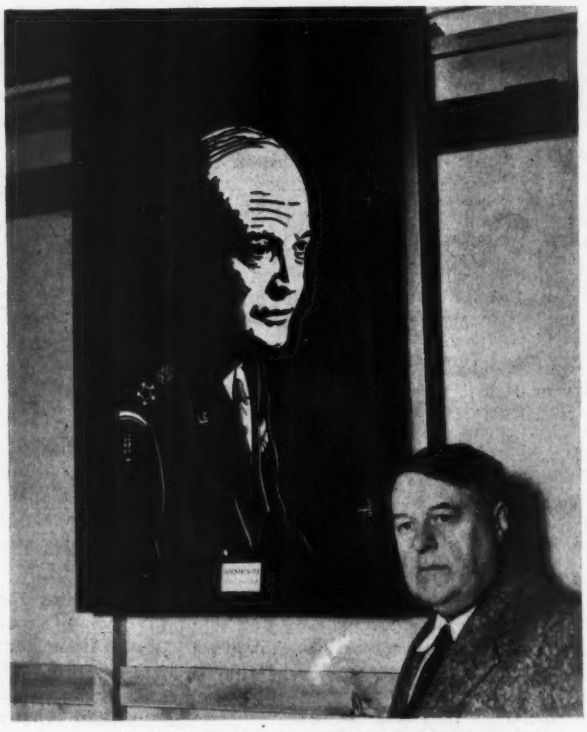
New Technique of Carving

Some notes on the work of the British artist, H. Brough-Robertson, and his creation of a new medium in art using laminated plastics.

DURING the last 25 years that we have watched the progress of the plastics industry we have seen very few impacts of art upon it. Those that we remember with interest and have reported upon include the very fine statues, each 12 ft. high, cast in phenolic resin by Ralph Mancuso, that were seen at the 1939 New York Fair, and, more latterly, the carving of large figures from cast "Perspex" by the sculptor, Dr. Fleischmann. We also remember the important work of Mr. Friese-Greene and his paper delivered to the Plastics Institute on the subject of "Plastics as Living Materials."

In the last month or so it has been our extreme pleasure to view the entirely new creations of the carver and sculptor, H. Brough-Robertson, in a medium of his own devising, which, so far as our knowledge goes, has never before been employed. His work, as we have said, has given us great pleasure, and has certainly stirred our imagination and our emotions; Mr. Brough-Robertson will accept that as a sincere appreciation.

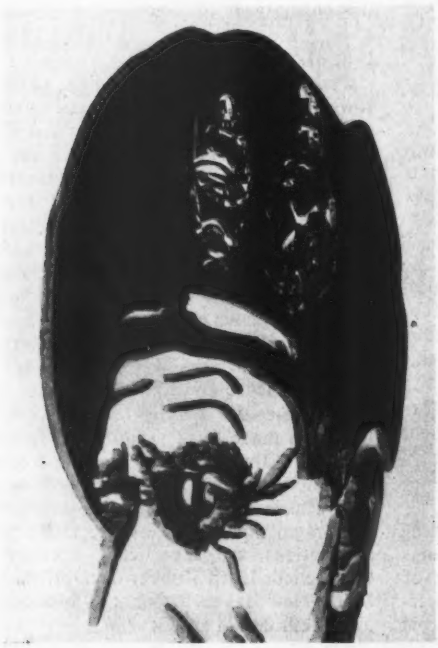
His raw material is one that in a very general sense is already well known to the electrical industry—the phenolic resin impregnated laminate in sandwich form with alternating black-white-black as used to manufacture indicator panels by engraving into the black and so exposing the white as letters, numbers, etc. It differs from the normal sandwich material in that the top black laminate is extremely thick, about ¼ in. It is this top black layer that is carved to produce the picture, but it is not merely the exposure of the white that produces the whole effect. We may quote Count Michael de la Bedoyère for a description: "The actual work comprises the carving away of the black, then giving three tones, full black, a middle tone when the black slopes away, and the white. Under various lightings all kinds of extra subtleties are revealed. From very near, the carving is like fretwork and quite unrepresentative. But as soon as one steps back the picture is revealed, most accurately drawn, and with a quite exceptional strength and dignity."



Mr. Brough-Robertson, with his portrait of General Eisenhower.

Eric Newton, the famous art-critic of the "Sunday Times," is equally enthusiastic and has written: "Brough-Robertson has completed a work of art in an entirely new medium—a medium of his own conception. The work is carried out in solid black plastic carved and polished to a fine eggshell surface and in places cut away so as to show a white ground. The resultant vigour of live subtlety of surface could have been achieved in no other medium."

Mr. Brough-Robertson chose the laminate because of its strength, its homogeneous nature, and its high resistance to all climatic conditions. Using it, he had to invent an entirely new technique of carving and success came only after long struggles and failures. He made General Eisenhower the subject of his first portrait in the new



Portrait of Field-Marshal Viscount Montgomery of Alamein. (Extreme left) Detail of head, distorted because of acute angle of photography, showing depth of the cuts in the laminate.

"Deposition," Mr. Brough-Robertson's rendering of the Entombment of Christ. (Below) Detail of one of the figures.

medium, because he was convinced that he was the most outstanding military personality during World War II; the result is the artist's own tribute to a great man. It was executed under the stress and strain of war and during the final blitzes of London—the artist does not know exactly how long it took, but he says: "I began when the General had three stars and finished it when he had five!"

The largest and latest work (it is 6 ft. by 5 ft. in size) is in the same medium on a religious theme, the entombment of Christ, and is called "Deposition." In reporting on this we can do no better than give the opinion of a famous critic: "The design with its Rembrandtesque emphasis emerging from darkness, speaks for itself. The patient and skilful craftsmanship, on the other hand, gives it a quality that is entirely lost in the photograph. Its inherent dignity and solemnity needs, of course, an appropriate ecclesiastical setting."

We shall await with keen interest further progress in this field.

Plastics in Building—V

By JOSEPH B. SINGER, B.Sc.(Arch.)

INHERENT properties of certain plastics drew the attention of manufacturers and of architects to the possibilities of using these materials for plumbing installations. Pipes of extruded polyvinyl chloride were first produced as early as 1938, and were used in the "synthetic house" at the Frankfurt Exhibition. War-time shortages, as also need for economy in the use of metals, led to further investigations in this field. Experiments on the suitability of vinylidene copolymer for pipework were carried out in the U.S.A. in 1943, particular attention being given to temperature effects and resistance to water pressure. The results showed that this type of plumbing installation could be used at temperatures below 150 degrees F. and with static pressures not exceeding 80 lb./sq. in., but subsequent tests proved that use at higher temperatures was also feasible.

The development of polythene ("Alkathene") tube in Britain marked another phase in the progress of plastics for plumbing. This material, however, can be used for liquids only below the temperature of 65 degrees C. (149 degrees F.), which limits the application to cold water plumbing.

In normal installations for water supply there is a definite division between cold and hot pipelines. From the rising main a supply of water is taken to the cold water cistern, from which other pipes branch off to carry cold water and also to feed the hot water cylinder for heating and distribution of hot water. The accompanying diagram (Fig. 1) indicates the way in which plastic pipes could be used in a typical installation throughout the whole of the cold water system. The problem of joining up such pipes with the street main, and with the cistern, could be solved by the use of standard threaded metal fittings or compression couplings.

The corrosion resistance of the plastics which are suggested for pipework is superior to that of metals; it is also unlikely that scale formation, due to presence of lime, etc., will occur in the cold water system.

The bursting of pipes, occasioned by the freezing of water and resultant stresses, is a common failing of traditional waterpipe materials, but is offset by the generally low thermal conductivity of plastics and their characteristic elasticity, which allows for dimensional changes. These properties are of particular importance for long runs of pipework in positions exposed to considerable differences of temperature.

The strength of plastic pipe is one of the main factors considered by prospective users; available data shows that the resistance of such pipes to hydraulic pressures is quite sufficient to meet the normal requirements. Normally, the pressure of water is from 25 to 80 lb./sq. in. Tests carried out on "Alkathene" pipes have revealed that pipe of ½ in. nominal bore can withstand an hydraulic pressure of 900 lb./sq. in. (¾-in. pipe, 600 lb./sq. in.), which although less than for metal is still adequate.

Traditional cold water service pipes are usually of lead; sometimes wrought-iron. Lead pipes have "wiped joints," in which one pipe is tapered and the other widened and shaped to receive it; thus assembled, a coating of semi-molten plumbers' solder is wiped round the joint. Branch pipes are fitted to a continuous run by cutting a hole in the side of the latter and, after fitting the splayed end of the former, the joint is coated with solder and wiped as previously. Wrought-iron pipes are connected by means of screwed ferrules or unions, bends and branches being made in special malleable castings or forgings.

The flexibility of plastics as piping, which otherwise is a valuable asset in enabling curved runs to be laid without special bends, makes it very necessary to provide frequent supports for fixing. For horizontal runs, continuous support in the form of fillets is most satisfactory.

Developments in plastics plumbing include the manufacture of soil pipes and waste-water pipes for sanitary fittings, but which do not come in contact with water above the temperature of 149 degrees F., e.g., mainly for water-closets and urinals, and in restricted cases for washbasins and sinks. In those positions where there is likely to be contact with water approaching the temperature indicated, a short run of metal pipe could be installed to allow the water to cool, if not in large quantity. Traps would be easily formed by hot-bending the pipes; ventilating (anti-siphonage) pipes could be attached to the waste near the trap, where necessary, to carry away the foul air. For this purpose, however, pipes of larger diameter than those available at the present would have to be produced.

The recent use of polythene pipes for irrigation purposes in agriculture, where experience has proved the resistance of plastics to soil corrosion, can serve as a pointer towards utilizing plastic pipe for drains. A survey of the existing materials, and of the problems involved in an efficient drainage system, helps one to appreciate the advantages that may be gained by the use of plastics.

The traditional drain is mainly of earthenware, or of cast-iron. It is laid to a fall by jointing socketed pipes of glazed earthenware, each 2 ft. long, into continuous runs with cement, the run being intercepted with manholes, where branches are connected to the main drain. The earthenware

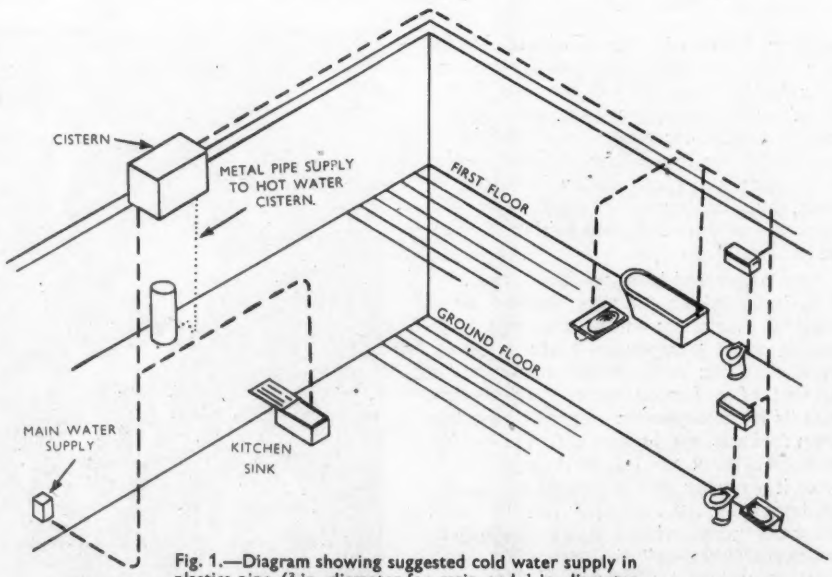


Fig. 1.—Diagram showing suggested cold water supply in plastics pipe (¾ in. diameter for main and ½ in. diameter for branches).

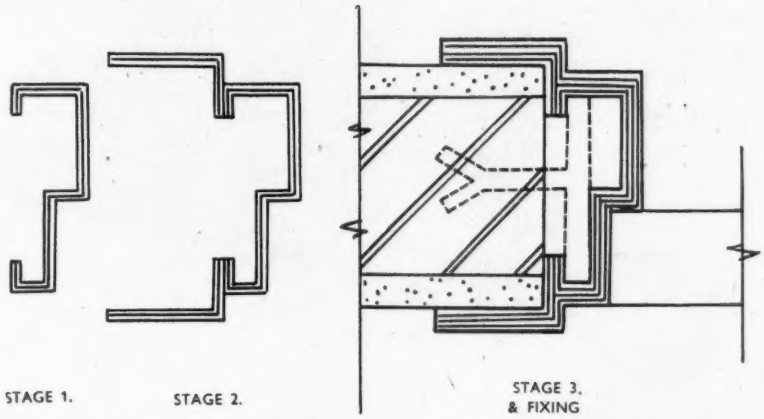


Fig. 2.—Diagram showing suggested manufacture of door frame in plastics.

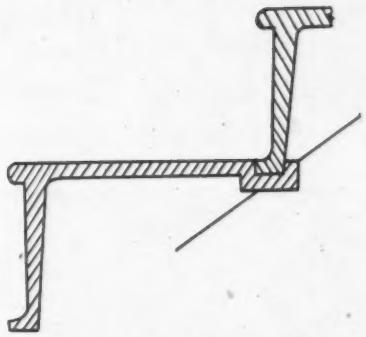


Fig. 3.—Suggested construction for tread and riser of staircase.

pipes are produced in 4-, 6-, 9- and 12-in. diameters and are laid in a 6-in. concrete bed.

It is suggested that drains of small-diameter plastics pipe, e.g., 4-in., could be manufactured for joining soil pipes and waste-water pipes to larger-diameter sewers. The following factors favour the application of plastics pipe for drains:—

(1) Savings in cost are effected by the rapidity and ease of laying a considerable length of pipe in one continuous run, and also in the elimination of frequent recurring joints, which are necessary for earthenware pipe. A reduction in the number of joints contributes also to a decrease of friction between the pipe and the flow of soil or waste, and this minimizes the possibility of clogging.

(2) Joints can be arranged to coincide with manhole positions to facilitate inspection.

(3) The jointing of pipes is easily performed by "welding" the plastics material.

(4) Flexibility of the tubes enables by-passing of obstructions in one continuous run, without the use of special bends, which are also liable to impede efficient drainage.

(5) Resistance of plastic pipe to earth pressure has yet to be investigated, but the normal practice of encasing drains in concrete should prove to be adequate.

Rainwater Goods

Very little research has been done on the possibility of using plastics for rainwater pipes and gutters. The established materials are mainly cast-iron, lead, zinc, and aluminium. Rainwater pipes are usually manufactured with 2 to 4-in. diameter, in 6-ft. lengths, and are jointed and secured with holder-bats or collars to the wall. Gutters are similarly produced in 6-ft. lengths, jointed and supported on brackets.

It is suggested that experiments be made with pipes made from resin-bonded laminated paper, which would be painted externally in a similar manner to the traditional pipes, partly to match the building and for protection. The method of jointing would be similar to metal pipes, i.e., enlarging one end to form a socket into which the other end would be bedded with a sufficient overlap. It is, however, realized that difficulties will be encountered in the production of rainwater goods with present-day plastic materials on a competitive basis, although such an enterprise is feasible.

Large Building Components

Prefabrication, which at one time was only intended to bridge a gap in the housing shortage, has gradually extended to cover new fields. The value of factory-produced components is universally recognized as a means for a rapid and economical method of building.

During the war, large units in plastics were produced for aircraft construction, and the rubber-bag process marked a new phase in prefabrication technique. In this field, resin-impregnated paper alone, or in conjunction with wood veneers, might provide a material for use in staircase construction, since prefabricated concrete staircases are already cast for external use in housing schemes, and it would not be unreasonable to advocate the manufacture of staircase units when their number can justify large-scale production and it is possible to employ inexpensive moulds which would allow for flexibility in design and replacement. Similarly, moulded door frames for internal walls and partitions, and plumbing ducts in standard sizes, are other practicable uses for this material. The examples illustrated are only indicative of some of the possibilities in utilizing plastics materials for large building components.

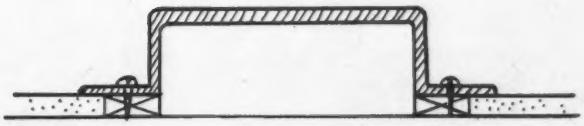


Fig. 4.—Construction of duct for service pipes, ventilation, etc.

(*To be continued*)

Polystyrene Developments

THE third evening meeting of the London Section of the Plastics Institute was held at the Waldorf Hotel on November 23, when a paper on "A Survey of Polystyrene Developments," prepared by Messrs. N. G. H. Thomas and D. G. Kavanagh, of the Monsanto Chemical Co., was read by Mr. Thomas. Over 200 members of the Institute and friends attended.

Mr. Thomas outlined the physical, mechanical and dielectric properties of commercial quality polystyrene, and compared and contrasted them with those of other plastics. He stressed the exceptional dimensional stability, electrical properties and clarity as well as the low water absorption of polystyrene, and showed clearly how the physical properties of the polymer improve as the temperature is reduced, whereas most other plastics become increasingly brittle at low temperatures. He then proceeded to discuss various applications for polystyrene, which had so far been barely touched in this country, including packaging, particularly in the field of re-use containers, certain articles used in cars and public transport vehicles, refrigerators, brush backs, domestic ware and so on. In these applications the importance of the annealing of mouldings, and the benefits to be derived therefrom, were stressed.

A wide range of mouldings of American origin, demonstrating the versatility of the polymer were exhibited.

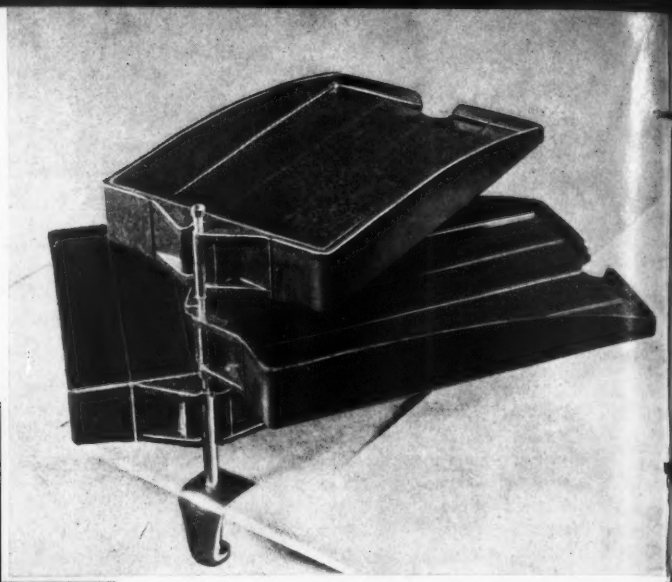
Finally, Mr. Thomas referred to the development in America of new grades of polystyrene, for instance, high impact, flame and heat resistant materials, produced for special applications, but although these products had met with some success, the greatest progress was to be expected in the improvement of the general-purpose polymer.

PLASTICS

IN THE SERVICE OF MAN

A pictorial review of high-quality units moulded or otherwise fabricated in Great Britain . . .

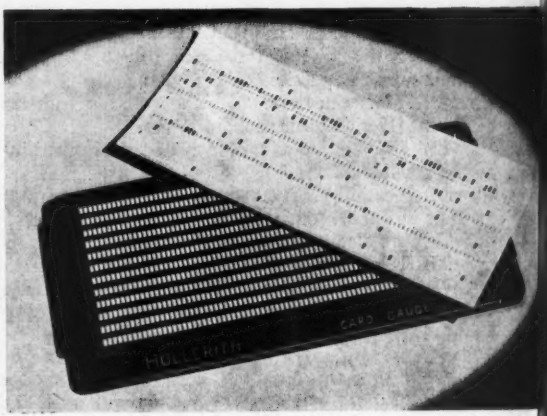
15. Office Equipment



(Above) The "Quicklo" desk tray unit, manufactured by J. Cook and Co., consists of three trays—moulded in walnut phenolic material by Insulators, Ltd.—mounted on a clamped-on metal support.

(Above) Two 20½-in.-diameter mouldings made by Ashdowns, Ltd., in "Bakelite" material, form the wheel of the "Cardineer" record cabinet, manufactured by the Chatwood Safe and Engineering Co., Ltd.

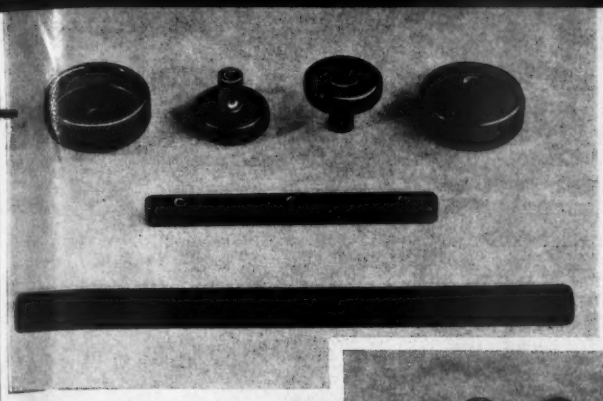
(Below) Card gauge of "Bakelite" material for punching cards for the "Hollerith" accounting tabulating machine, moulded by Charlsworth Mouldings, Ltd. (Photo : Bakelite Ltd.)



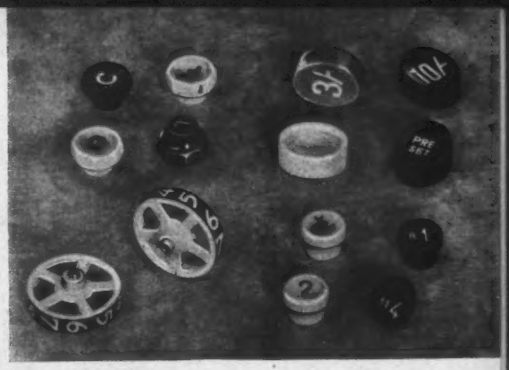
(Left) Desk calendar for "Plastics," with frame moulded in black phenolic material by Crystalate, Ltd.

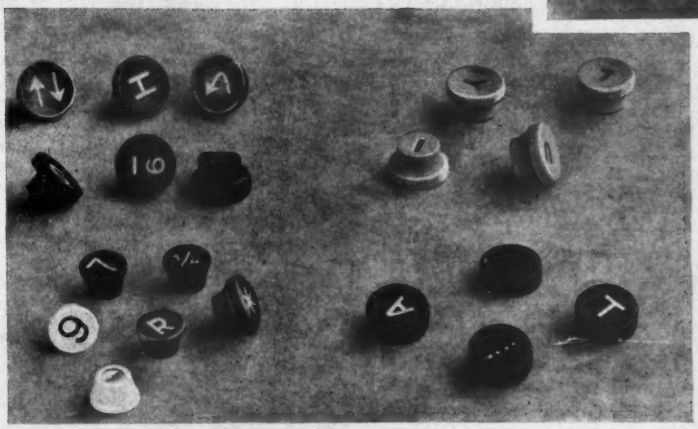
(Below) The base of the "Anson" pay-as-you-earn recorder (George Anson and Co., Ltd.) is a phenolic moulding (weighing over 4 lb.) manufactured by British Moulded Plastics, Ltd.

(Below) The housing and knobs of the "Ready-Note" desk note-pad are injection moulded in cellulose acetate by Punfield and Barstow, Ltd.



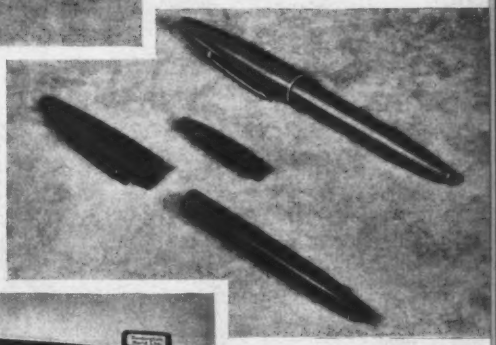
(Left) Platen turning knobs and spacer bars for The Imperial Typewriter Co., Ltd., are moulded by Birkbys, Ltd., in black phenolic material with metallic insets.





(Left and above) Typewriter and calculating machine keys are moulded by Bettix, Ltd., by various two-colour processes in "Diakon" methyl methacrylate (I.C.I. Ltd.) for the Monotype Corporation, Ltd., Gross Cash Registers, Ltd., and the Bell Punch Co., Ltd. (above); the figure drum units are also moulded for the Bell Punch Co., Ltd. The keys (left) moulded by the same firm in Tenite II cellulose acetate butyrate (Kodak, Ltd.) are for British Typewriters, Ltd., National Cash Register, Co., Ltd., the Agrell Machine Co., Ltd. and Oliver Typewriters, Ltd.

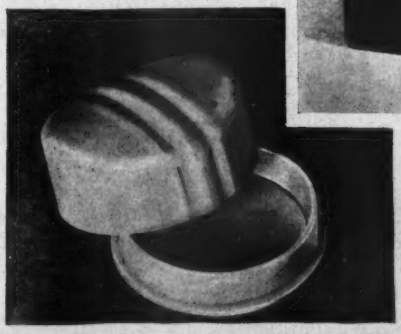
(Below) A dark brown phenolic moulding by Fraser and Glass, Ltd., forms the top and handle of the rocker blotter made by Rees, Pitchford and Co., Ltd.; the ruler, injection-moulded in black polystyrene, is another Fraser and Glass moulding.

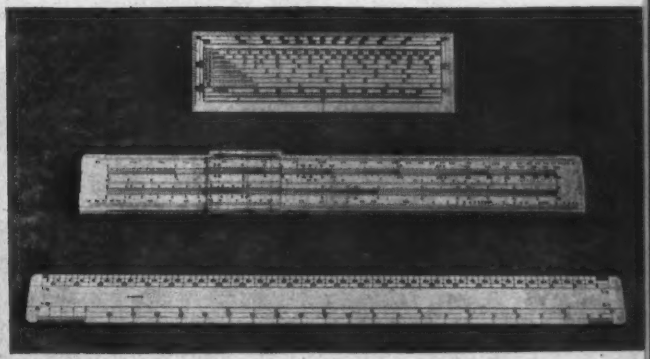


(Above) The holder of the "Nicholas" ball-point pen is injection moulded in three parts in cellulose acetate by Universal Metal Products, Ltd.

(Left) Guides for separating correspondence in filing cabinets, etc., are now made by Remington Rand Ltd. from "Delaron" phenolic laminate (Thomas De La Rue and Co., Ltd.).

(Right) Typewriter ribbons made by Ofrex Ltd. are now packed in a polystyrene container, which may be used, after it has served its original purpose, as a box for pins, clips, etc.





(Above and left) Rectangular protractor slide rule and Armstrong scale, fabricated from ivory "Perspex," and setsquare, circular protractor, French curve, bar parallel rule and 12-in. scale in transparent "Perspex," are manufactured by James Farrow.

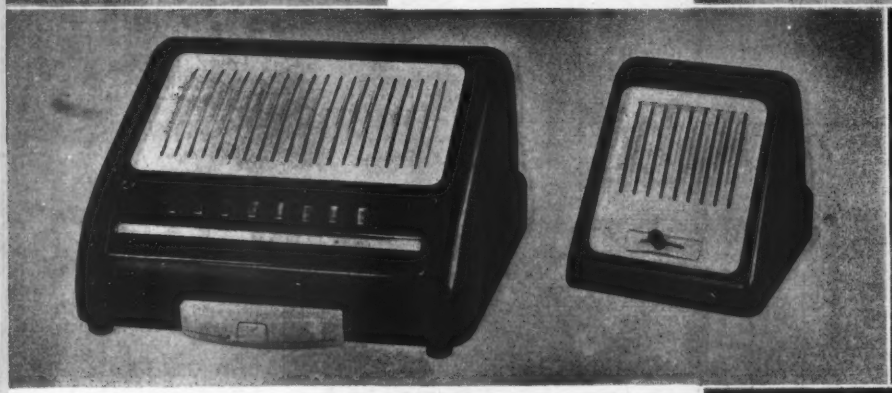
(Left) The cabinet of the "Ardente" Multicall intercom unit is moulded in black phenolic material by Crystalate, Ltd.

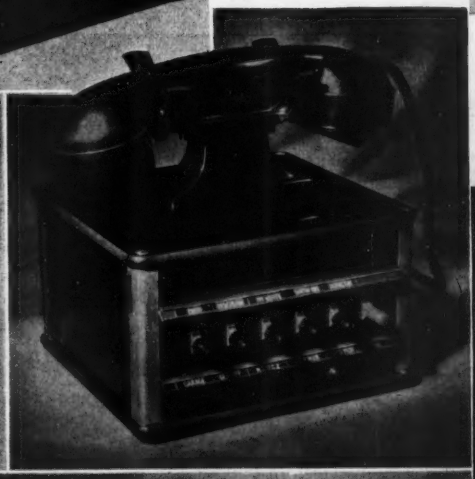
(Right) The phenolic desk calendar frame, holding 53 weekly cards, was moulded for Bowater Paper Corporation, Ltd., by British Moulded Plastics, Ltd. ("Plastics," 1948/March/141).

(Left) The "Recordon" dictating machine, manufactured by Thermionic Products, Ltd., recording on a magnetic oxide coated paper, is housed in a phenolic moulding.

(Below) To stand up to unusually hard conditions phenolic laminates are used to house some telephone sub-stations made by Dictograph Telephones, Ltd.

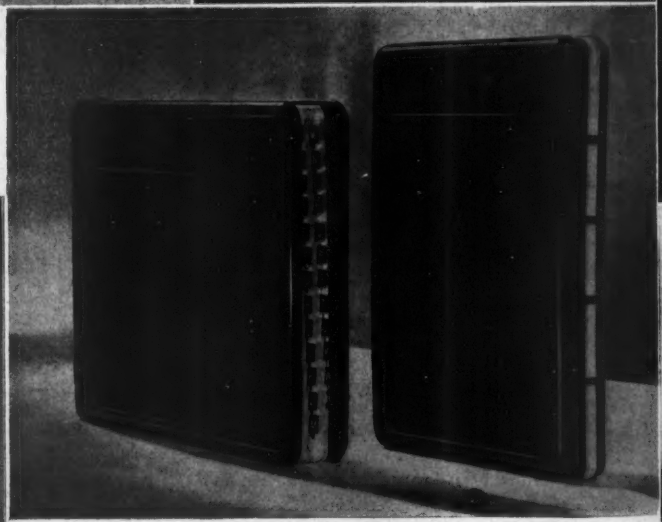
(Left) Where "Speedfix" self-adhesive cellulose tape is used in large quantities, the manufacturers, Ofrex, Ltd., provide a "trigger" dispenser moulded in plastic materials.





(Above) The master unit as well as the sub-station of the Ediswan "Loudspeakerphone" intercom system, manufactured by Edison Swan Electric Co., Ltd., is moulded in plastic materials by Insulators, Ltd.

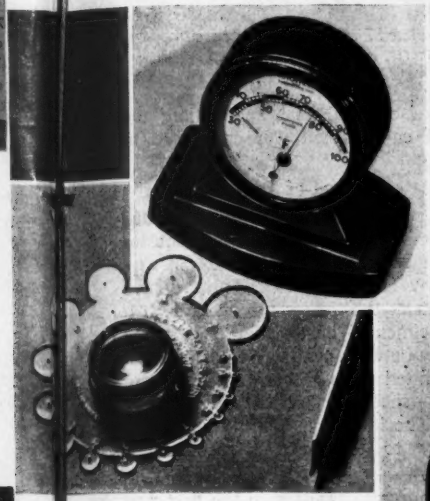
(Below) A thin paper disc coated with a magnetic oxide embedded in a plastic composition is the recording medium of the "Emidicta" dictating machine manufactured by E.M.I. Sales and Service, Ltd.

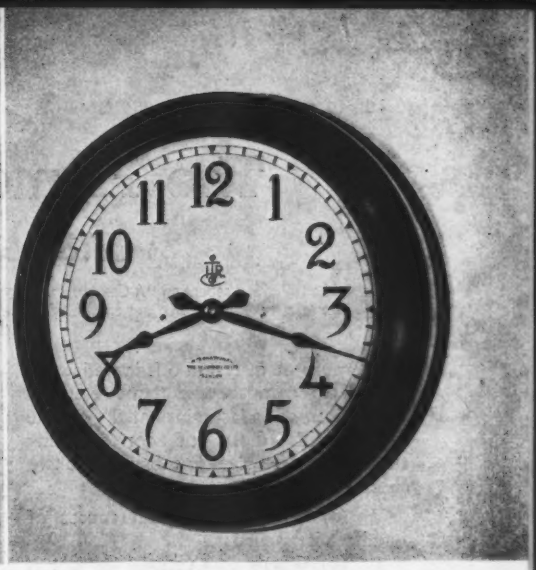


(Above) Because of their great strength and durability, "Bakelite" laminates are used in the "Kalamazoo" binder, made by Kalamazoo, Ltd. (Photo: Bakelite, Ltd.)

(Right) The housing of the "Adrema SHA" addressing machine (Adrema, Ltd.) includes a black cellulose acetate frame and a cream Perspex top, both manufactured by J. F. Kenure, Ltd.

(Below) The black phenolic case for a desk thermometer is moulded by Universal Metal Products, Ltd. The radius curve, a useful drawing instrument made for E. N. Mason, and Sons, Ltd., is injection moulded in polystyrene by the same moulders.

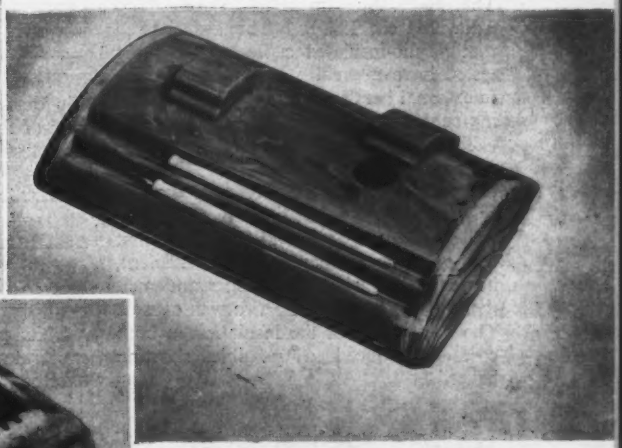


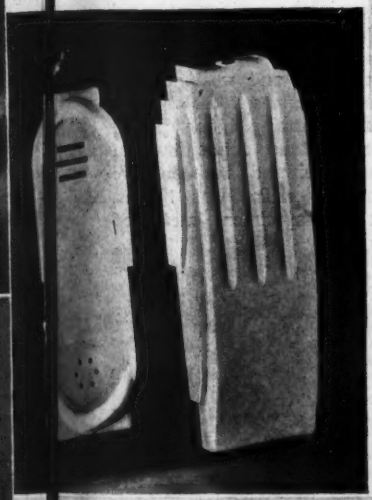


(Above) The International Superelectric Time Recorder employs a moulded plastic card receiver and transparent plastic window over the time indicator. The office wall clock (right) is housed in a phenolic moulding. (The International Time Recording Co., Ltd.)

(Below) The inkstand and the pin tray (below, left) are part of the "Carvacraft" series of decorative desk equipment fabricated in "Catalin" cast phenolic material by Catalin, Ltd.

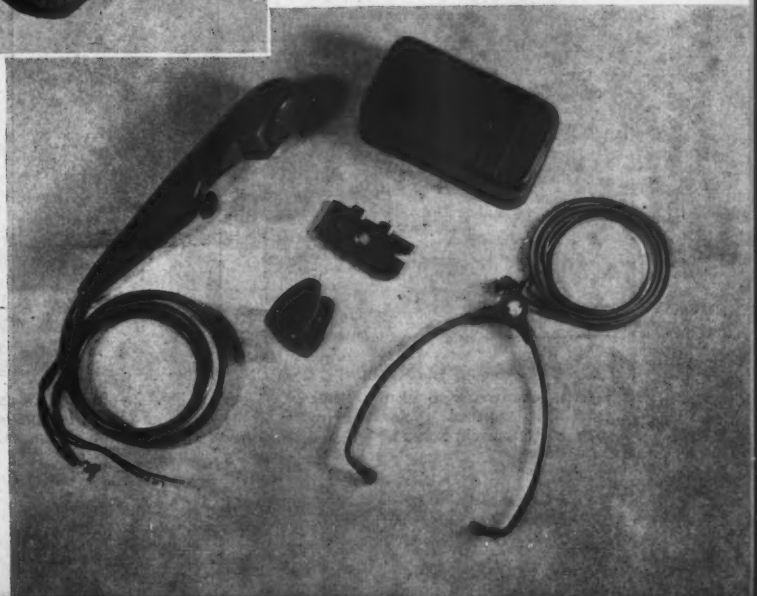
(Below) The "Intercall" telephone made by Shipton and Co., Ltd., is housed in a polythene case moulded in various bright colours.





(Above) The large hand wheel and various other components are moulded for the office equipment industry by Frederick W. Evans, Ltd.

(Below) Among plastic components of the Timemaster dictating machine made by the Dictaphone Co., Ltd. are the hand microphone and control unit cover moulded by Halex, Ltd., ear-phone clamp moulded by Insulators, Ltd., and ear-phone components by Ericsson Telephones, Ltd., all using Tenite II cellulose acetate butyrate. (Kodak, Ltd.)



The Flame-retardant Properties of Insulated Electric Cable

The following report on "A Comparison of the Flame-retardant Properties of Plastic-insulated and Rubber-Insulated Electric Cable" is based on tests recently carried out on behalf of the British Plastics Federation by the Fire Research Station, Elstree, Herts, and is here republished by kind permission of the Federation and the Fire Research Station.

THE purpose of test in this investigation was to compare the flame-retardant properties of plastic-insulated electric cables with those of corresponding rubber-insulated electric cables in the two cases:—

(a) Where an external source of heat is applied.

(b) Where an overload current is applied.

The first part of the investigation relating to the application of an external source of heat was carried out substantially in accordance with the test specified by the Underwriters' Laboratories Incorporated of America, in their Standard for Thermo-Plastic Insulated Wires (2nd Edit., March, 1945). The test showed that plastic-insulated cables of the types tested have a greatly superior resistance to external heating than have corresponding rubber-insulated cables.

The second part of the investigation, in which an overload current of 12 times the rated current capacity was applied, showed generally that the rate of heating was small, compared with that in the first part of the experiment. It was sufficient, however, to shrivel the plastics and melt the rubber, although no fire was caused. The breakdown of the insulation in both cases introduced a possible shorting hazard.

Description of Material Tested

The following types of insulated electric cable were subjected to the first part of the test. Three specimens of each type of cable were tested, cut into 20-in. lengths.

Table 1A

Cable	Insulation
7/029 Twin flat + e.c.c.	rubber
3/029 Twin flat	rubber
7/029 Single	braided rubber
40/36 3-core	rubber
19/064 Single	braided rubber
7/029 Twin flat + e.c.c. smaller dimensions than the B.S. 1557 type	polythene and p.v.c.
7/029 Twin flat + e.c.c. to B.S. 1557	polythene and p.v.c.
3/029 Twin flat	p.v.c.
7/029 Single	p.v.c.
40/36 3-core	p.v.c.
19/064 Single to B.S. 1557	polythene and p.v.c.
19/064 Single smaller dimensions than the B.S. 1557 type	polythene and p.v.c.

The following types of insulated electric cable were subjected to the second part of the test. Two specimens of each were tested, cut to 20-in. lengths.

Table 1B

Cable	Insulation
40/36	rubber
18 S.W.G. copper	p.v.c.

This part of the test was largely exploratory, to give an indication of the overload hazard, as compared with the hazard of external heat application; the types of cable tested were restricted to two.

Method of Test

Both parts of the test were performed in a chamber constructed of $\frac{3}{8}$-in. asbestos sheet, of external dimensions 24 ins. by 14 ins. by 12 ins. This chamber, which was open at the top, is shown in Fig. 1. The specimen to be tested was mounted vertically between two sets of three brass clamps fitted to two horizontal plates of asbestos sheet approximately 20 ins. apart. The lower plate could be moved vertically to tension the specimen if necessary.

The source of ignition in the first part of the test was a Bunsen burner with a $\frac{3}{8}$-in. orifice, fitted with a small pilot light. This burner replaced the Tirrill burner specified for the American test. The pilot light was adjusted so that it did not make contact with the specimen when the burner was in the position required for the test. The burner itself was adjusted to give a flame 5 ins. high, with a cone $1\frac{1}{2}$ ins. high, and was mounted with its axis at 20 degrees to the vertical, by means of a packing block placed beneath the base in such a position that the axes of the burner and specimen were co-planar, and the orifice was $1\frac{1}{2}$ ins. distant from the specimen, measured

Fig. 1.—Apparatus used for flame tests on insulated cable at Fire Research Station.

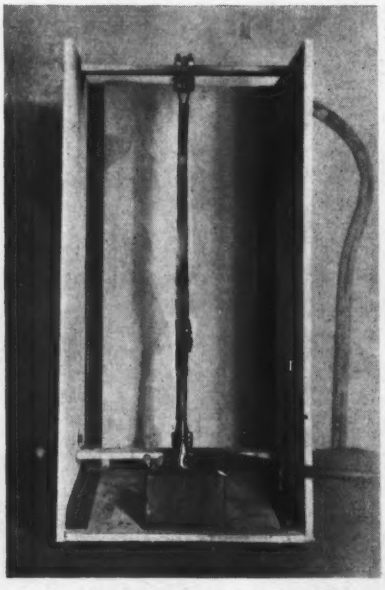


Fig. 2.—Rubber-insulated cable in flame test at instant of final application of Bunsen flame.

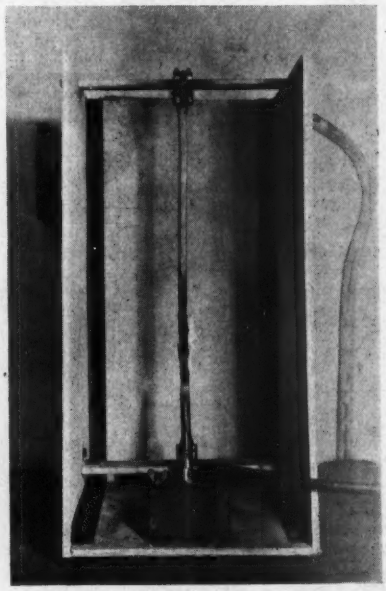


Fig. 3.—Plastic-insulated cable in flame test at instant of final application of Bunsen flame.

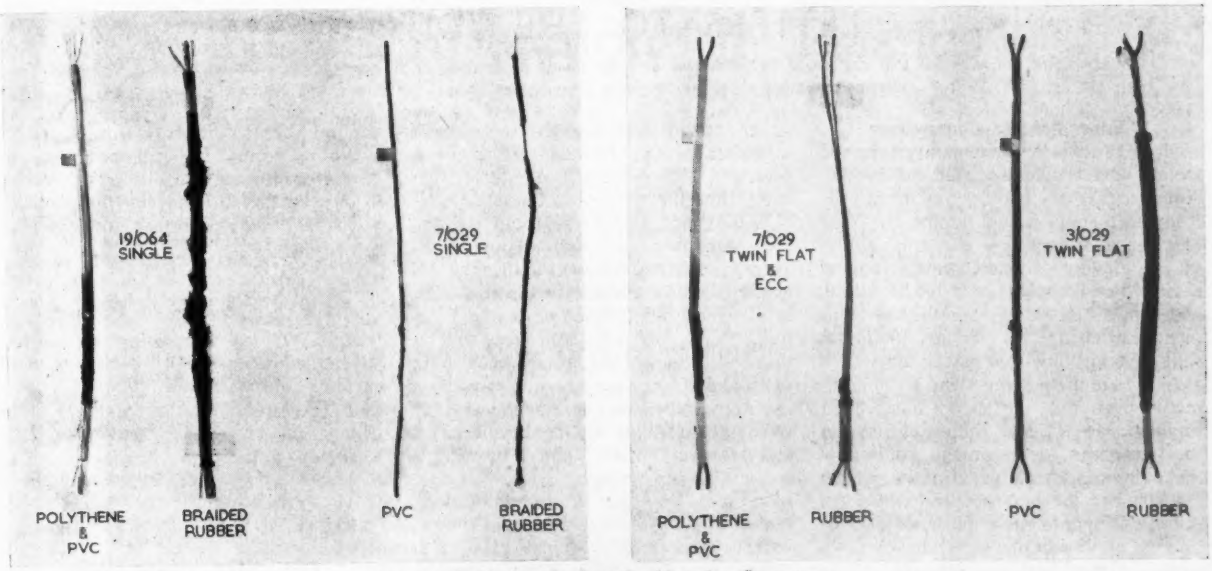


Fig. 4.—Condition of selected cables after flame tests.

along the burner axis, the point of application of the flame being 4 ins. above the lower end of the specimen. A flame indicator, made of a strip of gummed kraft paper, 0.004-in. thick and ½-in. wide, was wrapped once round each specimen with the gummed side towards the cable and the ends evenly pasted together and projecting ¾-in. from the opposite side of the cable to which the flame was applied. The indicator was positioned so that its lower edge was 10 ins. above the point of application of the flame. No current was passing through the cable during this part of the test. The flame was applied to the specimen for five 15-second periods separated by 15-second intervals, during which the valve supplying gas was closed. The length of time for which the specimen flamed, after the final application of the flame, was measured and the condition of the indicator was noted.

The standard which was adopted for assessing the flame-retardant properties of the insulation was that defined by the Underwriters' Laboratories Incorporated of America for the thermoplastic-insulated cable, namely, that the cable should not convey flame, nor should it flame for more than one minute after the last application of the test flame. The cable was considered to have conveyed flame if more than 25 per cent. of the indicator had burnt.

In the second part of the test, pertaining to the fire-hazard due to overloading, the cable was mounted as in the first part of the experiment. The current was passed through two cores in series, using the brass clamps as terminals. Each rubber-insulated cable tested had three thermocouples inserted in the conductor at 4¼-in. spacing, and at a similar distance from the ends of the insulation. No temperature measurements of the plastic-insulated cables were made. The applied current was adjusted to 5 amps. and the temperatures of the thermocouples were allowed to stabilize. The maximum and mean temperature rise of the three thermocouples were recorded. This was repeated in increments of 5 amps. to a final current loading of 60 amps. The hotter of the rubber-insulated cables showed a maximum stabilized conductor temperature rise of 385 degrees C., and a mean temperature rise of 262 degrees C.

The results of the first part of the test are shown in Tables 2A and 2B, relating to rubber-insulated and plastic-insulated cables respectively. The tables show the time of flaming after the cessation of heating, and the condition of the indicator at the cessation of flaming, the results quoted being those of the worst of the three specimens in each case. One plastic-insulated cable, the 40/36 three-core p.v.c.-insulated cable, was notable in having a considerably longer flaming period than the other plastic-insulated cables. It was also the only one in which string separators were used between the cores. No rubber-insulated cables employed string for this purpose. Fig. 2 shows a typical rubber-insulated specimen (7/029 twin flat) immediately after final extinction of the Bunsen flame; Fig. 3 shows a typical plastic-insulated specimen (7/029, polythene and p.v.c., twin flat) at a similar instant. The final condition of some selected specimens is shown in Fig. 4. All the plastic-insulated cables reached the standards for flame-retardant properties as defined by Underwriters' Laboratories Incorporated, while all the comparable rubber-insulated specimens failed to reach this standard.

Table 2A—Rubber-Insulated Cables

Cable	Insulation	Time of Flaming	Condition of Indicator
7/029 Twin flat +e.c.c... ..	rubber	longer than 60 seconds in all cases	destroyed in all cases
3/029 Twin flat	rubber		
7/029 Single ..	braided rubber		
40/36 3-core ..	rubber		
19/064 Single ..	braided rubber		

Table 2B—Plastic-Insulated Cables

Cable	Insulation	Time of Flaming (secs.)	Condition of Indicator
7/029 Twin flat +e.c.c. to B.S. 1557 (3 specimens)	Polythene and p.v.c	3 0 0	unaffected except for a small soot deposit
3/029 Twin flat	p.v.c.	0 1 0	
7/029 Single ..	p.v.c.	0 2 0	
40/36 3-core ..	p.v.c.	11 16 35	
19/064 Single B.S. 1557 ..	polythene and p.v.c.	0 0 0	
7/029 Twin flat +e.c.c... ..	polythene and p.v.c.	0 0 0	
19/064 Single ..	polythene and p.v.c.	0 0 0	

The second part of the test showed that both the plastic insulation and the rubber insulation failed under the heating effect of an overload current of 12 times the rated value, but in neither case did ignition of the insulation occur. The plastic insulation shrivelled and the rubber insulation melted.

Conclusions

All the samples of plastic-insulated cables passed the test specified by the Underwriters' Laboratories Incorporated of America, in their Standard for thermo-plastic insulated wires; samples of equivalent rubber-insulated cables failed. Both types of insulation broke down when the cable was heated by an overload current of sufficient magnitude, thus introducing a shorting hazard.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Window Balance Components

Sir,—The writer has recently returned from a visit to our associated company in America and has had an opportunity of studying their latest developments. One of these is to replace a particular fitting on a window balance, which is now a zinc die-casting (Mazak No. 5 alloy), with a nylon moulding. Another development is to change the steel or aluminium split covering tube to a plastic tube.

As we are the patentees and sole manufactures of this particular balance in England, we wish to follow closely on the American development, and now make inquiry as to who in the plastic industry are the best people to help us. As an example of the importance of considering plastics in our particular case, we would particularly mention the fitting which is being considered in nylon, as against the die-casting. Several samples of the die-cast fitting are enclosed.

From our leaflet you will see that, when the balance operates in a window, a variable-pitch spiral rod operates through the die-casting, which is always under torsion load through the action of a torsion spring. This die-casting, therefore, gets a considerable amount of wear every time the window is operated.

With good die-castings, both we and our American colleagues obtain an average of 50,000 reversals before the slot in the die-casting wears to a round hole, after which the balance ceases to function. Our American colleagues told us that, with the nylon fitting, they have reached 125,000 reversals on test without any appreciable wear in the slot.

The nylon fittings are therefore cheaper and also very much lighter, showing a great saving in transport cost. We ourselves use over half a million die-cast pawls a year and, with increased orders, will soon be reaching consumption of a million.

With reference to the tubular cover, we use 22-gauge half-hard aluminium, making this into a split tube by rolling from strip material. The tube is merely a cover for the spring assembly inside, and there is no reason why a plastic tube could not be used, providing it was robust and not likely to distort or bend with age.

We would like to get some English company interested in our requirements. Could you therefore suggest the name of a reliable organization that would be able to help us?

U.B.C.

P.V.C. Packaging for Poultice

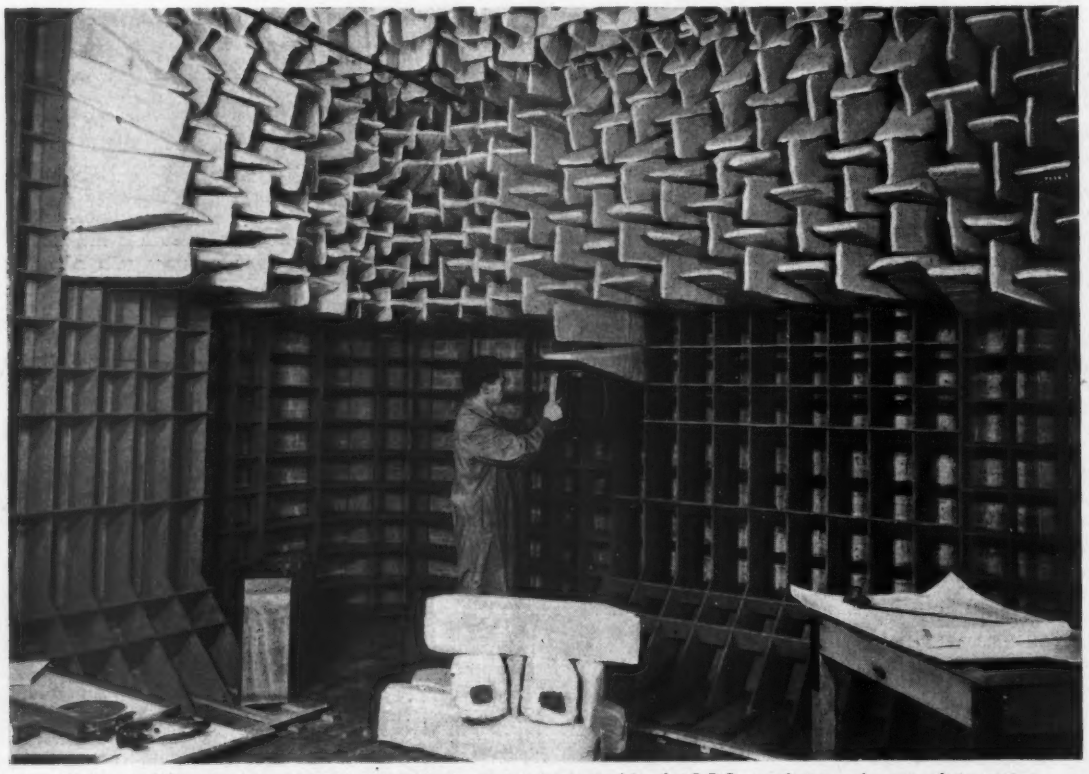
Sir,—We are attempting to market a product composed of kaolin poultice enclosed and welded within p.v.c. We shall be grateful for the names of firms who might be able to undertake such work.

J. H. PEPPER, LTD.
19a, Farm Road,
Hove, Sussex.

Plastics for Printing Blocks

Sir,—Would you kindly advise us of a source of plastic sheets suitable for making blocks for printing purposes, by moulding?

W. BROWN AND SONS.
20, Temple Street,
Wolverhampton.



Wedges of "Fibreglass" bonded with "Bakelite" resin are being used by the G.P.O. to obviate echoes in their testing chamber. Our photograph, reproduced by permission of the Engineer-in-Chief, G.P.O., and Bakelite, Ltd., shows the room under construction. The wedges are placed in the boxes covering the entire interior surface of the room. Echoes are so completely avoided that the most delicate sound tests can be carried out on microphones, etc. The non-reverberant efficiency of a room treated in this manner is said to be 99 per cent.

New Productions in Plastics

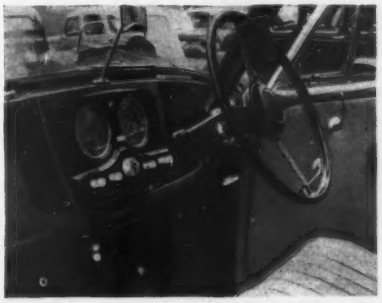
Instrument Panel

One of our photographs shows the instrument panel of the Triumph "Mayflower" saloon car. This panel, moulded by British Moulded Plastics, Ltd., is now made from cellulose acetate high-acetyl material. It is produced from a single impression mould on an 8-oz. Reed-Prentice injection moulding machine. It is by no means a simple job to make, because the plugs forming the numerous holes in the moulding restrict the flow of material and necessitate great care in order to avoid weld marks. Further, as the material stains the mould, the latter has to be plated. Another point that needed careful watching was the size and thickness of the bosses in order to prevent "sinking" on the front face. The feed enters centrally and was originally branched to each side so that the material entered the mould on two edges. In production, however, one of these gates has now been removed and the material feeds into one edge only.

Flower-pots

British Moulded Plastics, Ltd., recently laid down tools to produce flower-pots of three sizes, using low-cost filler with a phenolic resin binder. These pots have already proved a boon to the potted-flower trade, as they stand up to normal wear and tear much easier than the traditional flower-pot made of clay. In addition, they have a pleasing finish with a semi-shine, which enables them to be put on to a table without need to be camouflaged with a fancy exterior.

When put through the usual stringent tests by the Royal Horticultural Society at Wisley, these plastic flower-pots were awarded a "Highly Commended" certificate. They have also been tested over a period of 15 to 18 months at the John Innes Horticultural Institution, Bayfordbury, Herts, and at the experimental station of the Horticultural and Botanical Association, Ltd., Cheshunt, Herts, and the directors of both of these "horticultural universities" were entirely satisfied by their performance. At present the pots are produced in 3-in., 5-in. and 9-in. diameters, but further sizes will be introduced from time to time.



(Above) Moulded instrument panel as fitted in the Triumph "Mayflower" saloon car.

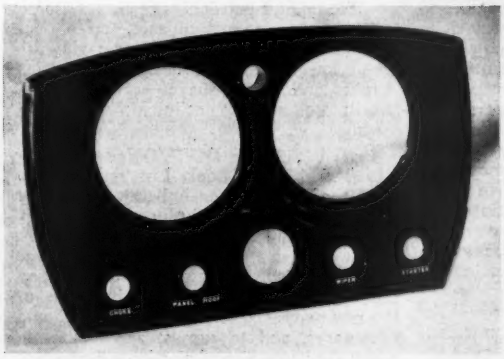
Binocular Magnifier

The "Bandalasta" binocular magnifier and eyeshade, a most useful instrument to inspectors, viewers, toolmakers and engravers, is fitted with prism lenses of 8-in. focal length and X2 magnification set in a black eyeshade, compression moulded from "Bakelite" material X20/5 by Brookes and Adams, Ltd., 250-252, Barr Street, Hockley, Birmingham, 19. The adjusting screw on the head-band is likewise moulded in "Bakelite." The eyeshade is neat in shape, comfortable to the wearer, and can be worn (if necessary) over spectacles.

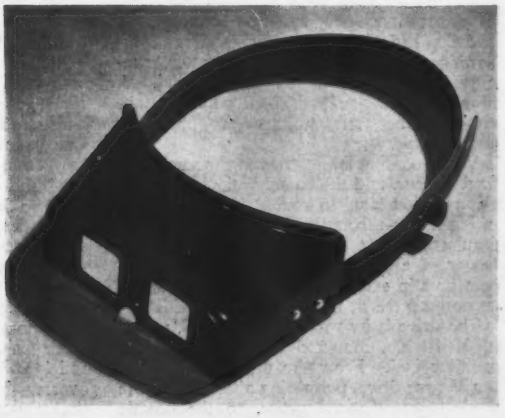
Shaving-soap Bowl
Solid Brilliantine Pack

These beautifully moulded containers are made by Universal Metal Products, Ltd., Salford, Lancs, for Cussons, Ltd., proprietors of "Imperial Leather" toilet products. The shaving-soap container has a cream-coloured bowl and red lid, engraved with the house sign in gold. In the brilliantine container the colours are reversed and the house sign is engraved and filled in red. The lids of both containers have start turn threads for quick, sure closure. Both containers are moulded from "Beetle" moulding powder.

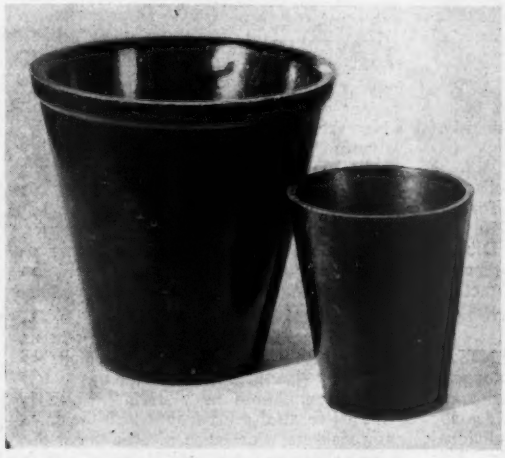
Previous packs in this range of products had the house sign affixed by a printed label. The engraving on these new packs represents a marked improvement and contributes materially to their attractive appearance.



Instrument panel.



Binocular magnifier.

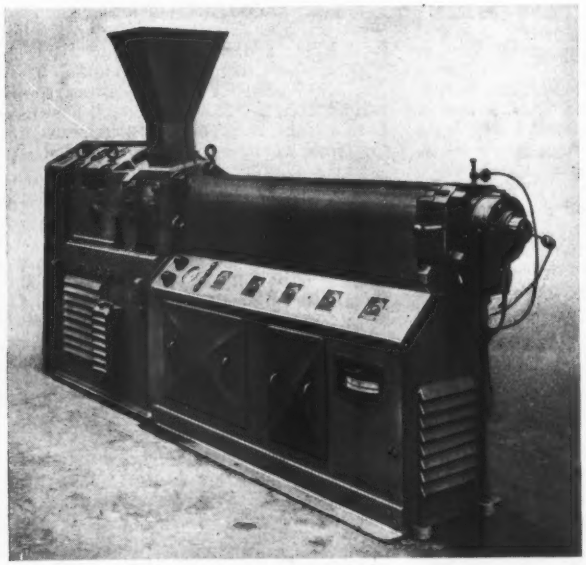


Flower-pots moulded in plastics.

Shaving-soap bowl and solid brilliantine pack.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes



New plastic extruder, 4½-in.-diameter screw, by Francis Shaw and Co., Ltd. (A smaller machine, 1½ ins. diameter, of similar design, is also being made.)

NEW PLASTIC EXTRUDER.—The machine illustrated (4½-in. size), together with a smaller one (1½-in. size) designed on similar lines, has recently been added to the range of plastics machinery made by Francis Shaw and Co., Ltd. The large machine has a long, hardened-steel screw, 4½-in. diameter, running in a cylinder of similar material. A hinged-type die-head is fitted which can be either of the "straight through" or "right angle" type.

Water cooling is provided at the screw and feed hopper, and the barrel and die-head are electrically heated in zones, the temperature of each zone being controlled by thermal regulator. A separately controlled die-tip heater is also included, and working temperatures in excess of 300 degrees C. can be accommodated at the die-head.

The drive is by variable-speed A.C. motor of 30/10 h.p. mounted inside the cast-iron machine bed. From the motor shaft there is a V-rope drive, permitting alteration to the stepless screw speed range, to the double helical reduction-gear unit, the shafts for which are mounted on anti-friction bearings throughout. A screw-speed indicator is fitted; also an oil-flow indicator in the feed to the thrust bearing and a hopper temperature indicator.

UNIT DUST COLLECTORS.—Visco Engineering Co., Ltd., Stafford Road, Croydon, have published a revised edition of their descriptive list of unit dust collectors for use with grinding and polishing machines. Units can be supplied for dealing with plastics dusts.

GAUGE AND TOOL MAKERS' ASSOCIATION.—The third Gauge and Tool Exhibition to be organized by the Association will be held in the New Hall of the Royal Horticultural Society, Elverton Street, Vincent Square, London, S.W., May 15 to 25 inclusive, 1951. Exhibits will include gauges and measuring equipment, jigs, fixtures and special tools; special purpose machines; press tools; portable power tools; moulds and dies; engineers' small tools; and diamond tools. Sixty-eight member-firms of the Gauge and Tool Makers' Association will be represented by exhibits.

Over 1,500 copies of the Association's model Apprenticeship Indenture, prepared and issued by the Education and Apprenticeship Committee, have now been disposed of to members of the G.T.M.A. and to firms in almost every other branch of engineering, for use in connection with their domestic apprenticeship schemes. Copies are available, price 3s. post free, on application to the offices of the Association, Standbrook House, 2/5, Old Bond Street, London, W.1.

At the end of 1947 the Association issued an export catalogue with separate editions in English, French, Spanish and Portuguese, and 14,000 copies were circulated to potential overseas buyers of tools and gauges in practically every country in the world. A second edition of this export catalogue is now being prepared in several languages and will be ready for circulation early in 1951.

KEY INDUSTRY DUTY.—The Board of Trade announces that the Treasury has made an Order under Section 10 (5) of the Finance Act, 1926, exempting the following articles from Key Industry Duty for the period beginning December 18, 1950, and ending December 31, 1950: Dibutyl phthalate, diethyl phthalate, dimethyl phthalate, dioctyl phthalate, 2-methylnaphthalene, 2-naphthyl benzoate, and para-formaldehyde.

"FREED GOODS" AMENDMENTS.—The Board of Trade has announced further additions and amendments to its List of "Freed Goods," i.e., goods which may be imported without individual licence from the usual list of countries. This concession dating from November 1, covers goods consigned from and originating in any country other than Albania, Argentina, Bolivia, Bulgaria, Canada, Colombia, Costa Rica, Cuba, Czechoslovakia, Dominican Republic, Ecuador, El Salvador, French Somaliland, Germany (Russian Zone), Guatemala, Haiti, Honduras, Hungary, Iran, Japan, Korea, Liberia, Liechtenstein, Mexico, Nicaragua, Panama, Philippines, Poland, Roumania, Switzerland, Tangier, United States of America, Union of Soviet Socialist Republics, Venezuela, Yugoslavia.

Referring to Appendix II in "Notice to Importers No. 401," to Group 5 (Chemicals, Drugs, etc.) is added polyisobutylene; and "camphor, natural" is amended to read "camphor, natural or synthetic." The categories of plastic goods have been revised.

The following entries are deleted:—

Casein plastic material in the form of sheets, rods, tubes, film and foil.

Celluloid film, foil, rods, rolls, sheets, strips, tubes, and profile shapes.

Cellulose acetate film, foil, rods, rolls, sheets, strips, tubes, and profile shapes.

Cellulose acetate moulding and extrusion materials.

Phenol and cresol formaldehyde moulding powders and resins.

Polyvinyl chloride.

Urea formaldehyde moulding powders and resins.

The above entries are now substituted by:—

Synthetic resins, solid and liquid, including adhesives—acrylic; melamine; phenol, cresol and urea formaldehyde; polystyrene; vinyl.

Moulding powders—acrylic; cellulose acetate; melamine; phenol, cresol and urea formaldehyde; polystyrene; vinyl.

Film, foil, rods, rolls, sheets, strips, tubes and profile shapes—acrylic; casein; cellulose acetate; celluloid; polystrene; vinyl.

I.C.I. PLASTICS DIVISION has recently issued a 16-page Book List setting forth details of the various bulletins, pamphlets and leaflets published by the Division. These publications are of two main kinds, designed to give respectively a brief outline and comprehensive details of the nature, properties and methods of fabrication of the raw materials, to describe their uses and advantages, and to suggest applications in which the properties of plastics will prove of value. Other booklets dealing with specific applications of certain products are also published.

WARERITE, LTD., Ware, Herts, have sent us a copy of their new brochure, "Bars in Warerite Laminated Plastics," illustrating various cocktail and snack bars where full advantage has been taken of the decorative value of "Warerite," and likewise its ability to withstand constant wear and tear, effects of spilt alcoholic liquors, and possible damage by cigarettes stubbed out or left burning on the surface of the bar counter. The names of architects and contractors concerned are given for each installation illustrated.

HELLERMAN ELECTRIC, LTD., Tinsley Lane, Crawley, Sussex, have sent us a copy of their new list giving details of dippings, low-pressure mouldings and injection mouldings in "Helvin," which is a special form of p.v.c. from which the company makes a wide range of articles for the radio, electronic, automobile and aircraft industries. "Helvin" is resistant to oils,

petrol, alkalis, acids, lower alcohols, ozone and light oxidation; is impermeable to water; and suitable for temperatures up to 80 degrees C., and in certain grades even higher temperatures. It can be used also, without detrimental effect and without cracking, at temperatures down to minus 40 degrees C. The low pressure mouldings are used for the production of grommets, supporting feet, shock-absorbing bushes, terminal coverings, bushes for television aerials, panel lenses, coverings for choke and magnetic coils, connecting leads with inserts, plugs, washers, etc. Special uses for "Helvin" include spring covers (which prevent ingress of water and dirt, but allow the spring to operate), cathode ray tube covers (which lessen the risk of implosion and protects the operator), lenses for signalling control panels and aircraft meter panels, control knobs (which grip shaft of control under tension, without use of pinch screws) and hand grips (applied to machine tool castings).

BAKELITE, LTD.—The autumn, 1950, issue of "Bakelite Progress" includes articles on "Bakelite Plastics in the Potteries," "Moulded Handwheels," "Bakelite Resins in Heat and Sound Insulants," and "Lightweight Fire Helmets." Mouldings in urea materials are also illustrated.

TELCOTHENE.—The Telegraph Construction and Maintenance Co., Ltd., Telcon Works, Greenwich, London, S.E.10, have published an informative booklet dealing with the properties of "Telcothene." Applications of this material in the form of tubing, mouldings, sleeving, sheet, rod and cord are the subject of illustrations. In rod form "Telcothene" can be cut or machined to produce brushes, coil and choke formers, insulators and many other electrical components. This characteristic is particularly valuable where small quantities are required or where it is desired to manufacture prototypes before engaging in the design of tools for larger production. The stock rod sizes are ¼-in. to 5-in. diameter, and average length 72 ins.; the smaller diameters are manufactured by a continuous process and are supplied in long lengths. Film, manufactured from unplasticized "Telcothene," is available in continuous rolls, .002 to .01-in. thickness and maximum width 6 ins.; it is also available in tape form on reels. Because of its excellent dielectric properties this film is extremely useful for a variety of electrical purposes.

AERO RESEARCH TECHNICAL NOTES.—Aero Research, Ltd., Duxford, Cambridge, inform us that stiff-covered binders holding approximately 50 issues of "Aero Research Technical Notes" are again obtainable from the company's Publicity Department at a cost of 6s. 3d. each.

BRITISH INSULATED CALLENDER'S CABLES, LTD., have supplied 750 yds. of television camera cable for the B.B.C.'s new Television Studio G at Lime Grove. This cable has been used by the Corporation for permanent wiring from the apparatus and control rooms to eight socket outlets conveniently disposed around the studio. The wall-mounted sockets have been specially designed for this installation, and, like the camera cable couplers, are integrally moulded in polythene to the cable end to form a sealed termination with all the circuits correctly disposed and screened. For the distribution of television picture and other video frequency waveforms throughout the Lime Grove Studios, 3,500 yds. of B.I.C.C. double-screened coaxial cable has been supplied. These cables have coloured p.v.c. sheaths for service identification purposes, seven colours (red, orange, violet, blue, green, yellow and grey) being adopted for the various services distributed.

BRITISH INDUSTRIAL SOLVENTS, LTD., announce the price of "Bisol" acetone has been increased by £15 per ton, as from December 4.

ERINOID, LTD., inform us that their London sales office address is now 96, Piccadilly, London, W.1. The company has also opened sales offices at 87, Cookridge Street, Leeds, and, for Glasgow, at 44, Douglaston Gardens, Milngavie, Dumbartonshire.

T. H. AND J. DANIELS, LTD., announce that Mr. Herbert Bayliss Dauncey has been appointed a director of the company, to date from October 1, with special responsibility for the development of new methods for reducing cost and increasing productivity. Mr. Dauncey has been with the company since 1907, and has held the position of works manager for the past 30 years.

WILFRID SMITH, LTD., chemical manufacturers and merchants, 16, Philpot Lane, Eastcheap, London, E.C.3, announce that Mr. James B. Morgan has recently joined the board. Mr. Morgan has served this company for over 25 years.

TENAPLAS, LTD., Upper Basildon, near Pangbourne, Berks, inform us that they have recently received orders covering a total of over 950 miles (five million feet) of polythene-covered and p.v.c.-covered twin-flat wire from a firm in New York. It is to be used for electrical purposes.

Mr. H. P. Bridge, managing director, British Moulded Plastics Ltd.; director, National Plastics Ltd., Moulded Products Ltd., Scottish Plastics Ltd., Lanarkite Ltd., Thomas De La Rue and Co., Ltd.

This drawing was made by Fred May, the well-known cartoonist.

Forthcoming Meetings

Jan. 16.—"The Melt-viscosity of Some Phenol-formaldehyde Novolac Resins," by Dr. T. T. Jones (Bakelite, Ltd.). Society of Chemical Industry, Plastics and Polymer Group, 26, Portland Place, London, W.1, at 6.30 p.m.

Jan 17.—"Dental, Medical and Veterinary Plastics," by Dr. S. A. Leader. The Plastics Institute, Southern Section. Polygon Hotel, Southampton.

Jan. 19.—"Decorative Laminates," by C. N. Jenkins (Bakelite, Ltd.) and H. S. Newcomb (Warerite, Ltd.). Plastics Institute, Midlands Section. James Watt Memorial Institute, Great Charles Street, Birmingham, 6.30 p.m.

Jan. 23.—"History and Development of Thermosetting Materials in the Rayon Industry," by A. Beecham. Plastics Institute, London Section. Waldorf Hotel, Aldwych, London, W.C.2, 6.30 p.m.

Jan. 24.—"What is this Production Control," by H. F. Webb (Diesinking and Engraving Co., Ltd.). Institute of Works Managers. Waldorf Hotel, Aldwych, London, W.C.2, 6.45 p.m.

Jan. 24.—"New Materials for Industry." Chance Memorial Lecture, by P. C. Allen (I.C.I., Ltd., Plastics Division). Society of Chemical Industry, Birmingham, at 6.30 p.m.

Jan. 26.—"Lost Wax Precision Casting," by J. S. Turnbull (Metropolitan-Vickers Electrical Co., Ltd.). Plastics Institute, North-western Section.

Jan. 30.—"Developments in Plastics Moulding Plant," by J. L. Daniels (T. H. and J. Daniels, Ltd.). Plastics Institute, North-eastern Section.

Jan. 31.—Dinner, Imperial Hotel, Birmingham. Plastics Institute, Midlands Section.

Feb. 7.—"Natural Polymers," by J. K. N. Jones. Plastics Institute, Western Section, Gloucester, 7 p.m.

Feb. 7.—"Costs, Oncosts and Waste," by C. H. Starr (Telegraph Construction and Maintenance Co., Ltd.). Plastics Institute, Yorkshire Section.

BOOKS RECEIVED

"Solvents." By T. H. Durrans, London: Chapman and Hall, Ltd. 21s.

"Plasticisers." By D. N. Buttrey, London: Cleaver-Hume Press, Ltd. 18s.

"Annuaire de l'industrie du caoutchouc, 1950." Paris: Editions Camille Rousset.

"Artificial Fibres." By R. W. Moncrieff. London: National Trade Press. 25s.

"British Catalogue of Plastics, 1950." London: National Trade Press. 50s.

"Plastics Moulding Engineering." By M. Freund. London: Sir Isaac Pitman and Sons, Ltd. 45s.

"F.B.I. Register of British Manufacturers." 1950-51. London: Federation of British Industries. 42s.

The Daniels Process Timer

This month we publish details of a second device for automatic moulding control, with an "exploded" drawing of the mechanism of the Daniels process timer, introduced by T. H. and J. Daniels, Ltd., of Stroud, and first described in "Plastics," January 1950, page 21.

THE Daniels process timer was primarily designed for use with thermosetting plastics moulding presses. The operation of a press equipped with this device is extremely simple; the operator merely loads the press and closes it, leaving the timer to take charge of the press until it opens at the end of the moulding cycle, and the finished mouldings are ejected.

The press shown (Fig. 1) is of the self-contained type, using a high-speed motor-driven hydraulic pump and piston-type control valves. These control valves consist of a spool, into which a number of recesses are machined. The body, into which the spool is lapped, has ports, two of which are connected to the press cylinders, one to the high-pressure supply (the pump) and one to release. Dependent upon the position of the spool within the valve body, the high-pressure supply may be passed to the top of the press cylinder, and the oil underneath the head of the ram passed to release, so that the press will close, and pressure will be applied to the mould, or high pressure may be admitted to an annulus underneath the head of the ram and the top of the cylinder opened to release, so that the press opens. There is a third position of the control valve, in which both the connections to the press cylinder are blanked off and the ram remains stationary, but this position is not used when a Daniels process timer is fitted.

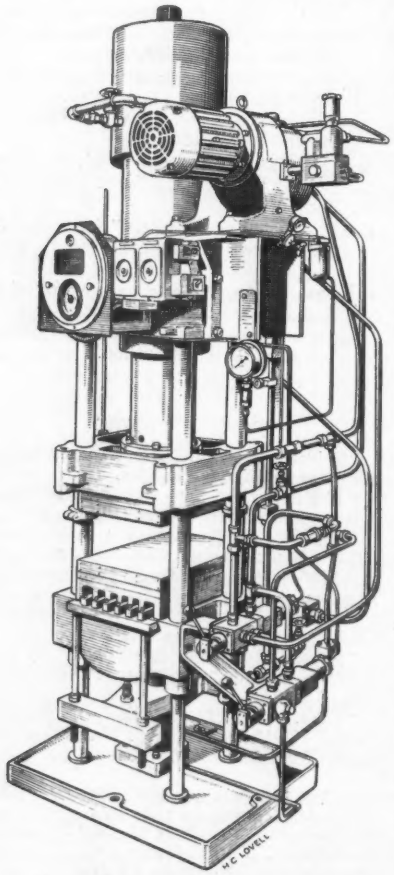


Fig. 1.—Daniels 125-ton double-acting down-stroke pre-filling press, with Daniels process timer in position.

It will be seen that the particular press referred to in this article is fitted with two control valves. The upper one operates as described in the previous paragraph, whilst the lower one, which is identical in construction, controls the small cylinder underneath the press table, which ejects the finished mouldings at the end of the moulding cycle.

When the process timer is in use, the control valves are operated by small, double-acting air cylinders mounted behind them. These cylinders contain a piston, connected by a rod to the spool of the press-control valve. Air at approximately 25 lb. per sq. in. pressure can be admitted into the cylinder on each side of the piston, causing the piston to move along the cylinder, in turn moving the spool of the control valve and operating the press.

It will be seen from the drawing of the interior of the process timer (Fig. 2) that it contains a shaft (1), carrying four metal discs (2) (3) (4) (5) (to which metal lobes can be attached), two insulated discs (6) (7), which operate electrical contacts, a pawl and ratchet (8), which prevent the shaft from rotating in the wrong direction, and a setting disc (9), divided into 30 divisions, each of which represents one second. The shaft is driven by a synchronous electric motor, via a gear train, at a speed of two revolutions per minute.

Above each of the four metal discs is an air valve (10) (11) (12) (13), which is operated by the lobes attached to the cam discs. In the drawing, a lobe on one of the cam discs (3) is in action operating its air valve, which allows air to pass to one side of one of the air cylinders mounted on the press-control valves.

The four air valves are normally arranged so that the one on the extreme left (10) causes the press to open; the next one (11) causes the press to close; the next (12) causes the hydraulic ejector ram to move upwards; and the one on the right (13) causes the ejector ram to move downwards. In the case of a transfer moulding press, the second pair of valves operates the transfer cylinder, which is fitted instead of the ejector cylinder.

The complete cycle, assuming that a moulding is to be made in urea, is as follows:—

The press is open, with the camshaft of the process timer at zero. The contacts, which are operated by the left-hand insulated disc (6) are broken, due to the lower one having dropped into the recess in the disc Whilst these contacts are open, current cannot flow through the camshaft motor. (In the drawing, one of the contacts can just be seen behind the insulated disc, which is *not* in the position it would normally occupy at the beginning of the cycle.)

The operator moves the control valve by hand, so as to close the press. This operates a micro-switch, in parallel with the contacts already mentioned in the previous paragraph, causing the camshaft motor to drive the camshaft. Lobes on the first two cam discs (2) (3) operate the press-control valve, via the air valves and air cylinders, so that the press opens very slightly and immediately closes again, so that any gases may escape from the mould. This operation of "breathing" can be carried out twice if necessary.

The contacts operated by the second insulated disc (7) now come into operation. This disc is set so that, when the breathing operations have been completed and pressure has built up on the main ram, a contact falls into a recess cut into the periphery of the disc. In the drawing, this has just taken place. This causes two things to happen: the supply of current to the camshaft motor is interrupted, so that the camshaft ceases to rotate, and the clutch in the timing clock (16), the dial of which can be seen in the drawing, is energized.

This clock has already been set to the time necessary to cure the moulding. After this time has elapsed, a contact is made inside the timing clock which starts the camshaft motor again. When this happens, a second contact falls into the recess in the cam disc, so that the supply of current to the camshaft motor is maintained after the contacts in the timing clock have been broken. The clock is then automatically reset ready for the next cycle.

The moulding now having been cured, a lobe on the left-hand cam disc (2) opens the press. The two right-hand cam discs (4) (5) now come into opera-

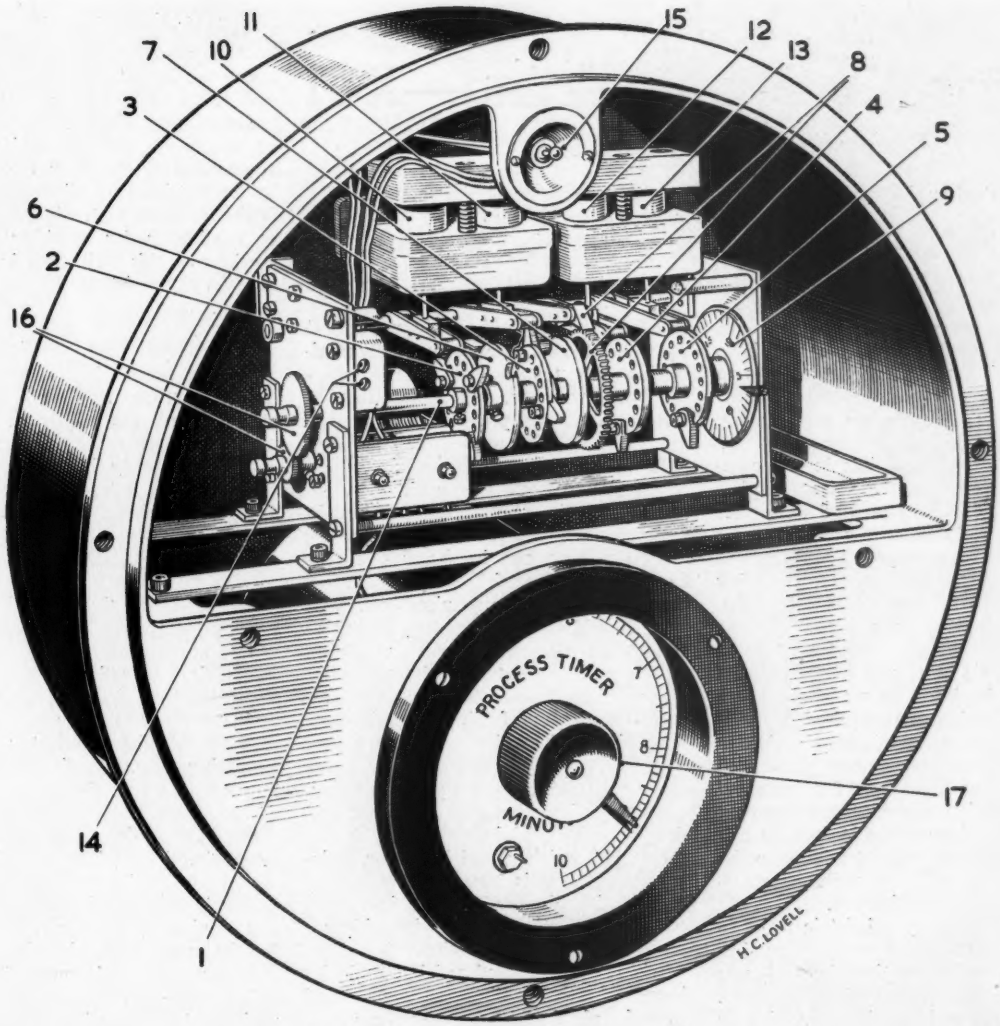


Fig. 2.—The mechanism of the Daniels process timer.

1.—Shaft. 2.—First cam disc controls all opening movements of main ram of press; it raises the press to breathe twice and at end of cycle. 3.—Second cam disc controls all closing movements of main ram; it lowers the press after breathing. 4.—Third cam disc controls all upward movements of ejector or transfer ram. 5.—Fourth cam disc controls all downward movements of ejector or transfer ram. 6.—First insulated disc controls contacts for camshaft motor. This disc keeps the camshaft running after start button is pressed, and stops camshaft at end of cycle. 7.—Second insulated disc controls camshaft motor and also cure-cycle clock motor. This disc stops the camshaft motor at start of cure, starts timer for cure, and stops timer at end of cure. 8.—Pawl and ratchet prevents shaft from rotating in wrong direction. 9.—Setting disc is divided into thirty divisions each equal to one second, or otherwise to suit interchangeable gears (16). 10, 11, 12, 13.—Air valves (the function of each valve is explained in the accompanying text). 14.—Terminals for electricity supply. 15.—Main switch. 16.—Interchangeable gears; the standard gears give two revs. per minute. 17.—Timing clock, with adjustable setting for timing period.

tion, causing the hydraulic ejector to move upwards to eject the moulding and then down again, so that the mould may be cleaned and reloaded with powder. The camshaft motor continues to operate until the disc on the right-hand end again indicates zero, when the contacts on the first insulated disc again drop into the recess on that disc and the press is ready to commence another cycle

When moulding with breathing—which is usually only necessary when using urea and melamine resins—it is found that the rapid movements of a down-stroke press are a disadvantage, as there is a tendency to blow some of the powder out of the mould. Accordingly, Daniels have developed a slowing valve, which is fitted in the line between the control valve and return cylinders (or annulus). This valve is of the sliding-piston type, incorporating two adjustable needle valves, one for upward and one for downward movement. At any predetermined point in the stroke of the press it can be arranged that the return fluid is directed via a needle valve, thus restricting the flow and slowing the press. This can be done both at the bottom of the stroke (when breathing) or the top, for gentle ejection if the hanging-bar type of ejector gear is used. The slowing valve can be seen at the rear and slightly to the right of the main control valve.

The use of the Daniels process timer ensures that the curing time and "breathes" are identical for each moulding. Once the instrument is set up correctly for a production run, there should be no faulty mouldings due to under- or over-curing. In addition, as the operator, once the press has been loaded and closed, need not do anything further until the moulding has been ejected, he has more time available for "de-flashing" finished mouldings or removing any loose pieces which may be ejected with the moulding.

If it is necessary to operate the press by hand, the process timer may be put out of use by the switch (15) on the front of the case, thus allowing the piston-control valves to function normally.

Successful Designing for Plastics Moulding—XVI

By W. M. HALLIDAY

Continuing the study of individual features of component design, the author now considers the design and application of ribs which may often be advantageously incorporated as part of the design for a moulded article

BOTH the component designer and the mould designer will often have recourse to the extensive use of ribs to accomplish a variety of practical functions or to meet some specific requirement. For example, by the introduction of ribs at carefully selected points in the component construction, the article may be more closely adapted to fulfil its service functions. On the other hand, appearance and æsthetic value may also be improved by such means. Further, the fashioning and operation of the moulding tool can be achieved more economically by the use of ribs.

Ribs will be employed to the greatest advantage in injection or compression mouldings which are required to meet special considerations of strength, rigidity and resistance to bending or deflection, as in the case of mouldings for industrial uses. By using ribs in the component design form, these valuable features can often be attained without adding to the weight of the article, or unduly increasing its general wall thickness.

Ribs are also very helpful in promoting the appearance of a moulding, i.e., as means for interrupting the plainness of extensive perfectly flat glossy surfaces. With the latter, if unrelieved by ribs or some similar feature, general appearance may be considerably impaired due to the presence of such defects as surface flow markings, minute blistering, roughened surface spots, open weld lines, sinkings, surface cracking, and so forth.

All such surface faults will, of course, be appreciably magnified and accentuated if situated upon large flat shiny surfaces, which of themselves possess poor light-reflecting qualities and where the high lights will be spread over large areas.

As an alternative to the use of such completely unrelieved flat surfaces, the designer may provide for a slight degree of curvature, coupled with a number of carefully disposed ribs, or ribbed-up edges. By this means the light-reflecting capacity will be improved. Ribs of this kind will also often materially assist in concealing the unavoidable slight defects formed on such surfaces.

It will also very often be practicable for such ribs to be laid-out or worked into an attractive pattern, thus enabling defects to be hidden in a still more effective manner, and at the same time to increase the strength and mechanical rigidity of the component by greatly minimizing the tendencies towards after-moulding warpage. Patterned ribs of this character will provide much smaller areas of high light reflection.

A variety of rib shapes and forms are, of course, available to the designer, but some care will have to be exercised in their selection so that the form ultimately chosen will be one in the closest conformity with essential mould manufacturing and operating requirements.

It should be appreciated that ribs cannot be disposed more or less at random at any point upon the surface of the component, nor can peculiar and awkward shapes of rib be specified to the whim of the uninformed component designer who may be unaware of important mould-making and operating needs.

Before stipulating rib locations and shapes it will be advisable to consult with the mould designer, and it will be desirable to allow this latter person a good deal of discretion and latitude in respect of the introduction of such ribs with any projected component design.

With many moulded articles it will be found that the quality, appearance and general physical properties can be improved, and that reproduction of articles from the mould may be facilitated to a large extent by the adoption of judiciously disposed ribs of the kinds now to be explained and illustrated.

It has to be remembered by the component designer that one of the chief problems confronting the moulding engineer, when having to produce parts of certain designs, is that of avoiding distortion, cracking and warping. All these disadvantageous features may arise during the time the component remains in the mould prior to ejection, or later when the part is removed from the mould, and is subject to the free contraction stresses. If the component has to be provided with large flat surfaces, or relatively thin section, and completely unsupported by stiffening bosses, ledges or ribs, externally or internally situated, warping troubles will be very prone to occur.

It is for these reasons that the mould designer should be afforded the maximum opportunities to introduce ribs for the successful elimination of those troubles.

Various types and shapes of ribs may be employed. They range from the very shallow raised projection, having a height of only a few thousandths of an inch above the normal external surface of the wall, to the substantially raised projection.

The shallow kind of rib will generally be employed purely to improve the appearance of the part; the other type, having considerable height above the wall of the moulded part, will be used mainly as a stiffener for bracing unsupported portions of this wall, thus increasing its strength and resistance to bending or distortion.

Some Common Forms of Ribs

Size and shape of rib will, of course, be largely determined by the purposes to be attained, and the ability of the mould maker to reproduce the form successfully and economically in the mould cavity contours. This latter consideration should always be kept well in view when selecting rib forms and sizes, and their location on the outside or inside surfaces of the component wall.

The sectioned diagrams of portions of a component wall, shown at Fig. 1, illustrate a number of common types of ribs and their application. These diagrams also serve to indicate certain undesirable design features which are to be avoided by the moulded component designer when specifying ribs. Preferred forms are illustrated, the adoption of which will ensure much more satisfactory quality in the finished article, and give the maximum simplicity of reproduction in the mould, and during the moulding process.

The form of rib shown at (A) is generally employed upon an external surface for the purpose of enhancing its appearance, or to conceal some minor surface defect which otherwise would be thrown up into prominence. The introduction of a shallow rib of this kind will often be invaluable for breaking or interrupting extensive flat plain surfaces.

As will be observed, this type of rib is only of moderate height above the top surface of the wall. The sides of the rib are very acutely inclined so as to bring the crest almost to a sharp edge. It will be advisable, however, to avoid having a perfectly keen corner at the top of the rib, especially in the case of a compression moulding in thermosetting materials. A slight radius at the crest in the manner depicted will often considerably simplify the reproduction of the rib channel in the tool. It will also be the means for preventing nicking and snipping when the finished product is handled or when it is in service.

Razor edges and sharp corners on a moulded component are always to be avoided for a variety of practical reasons, one of the chief being their liability to chip and snip easily. A ragged, broken and uneven edge at the crest of patterned ribs, for instance, will mar the appearance of the finished article.

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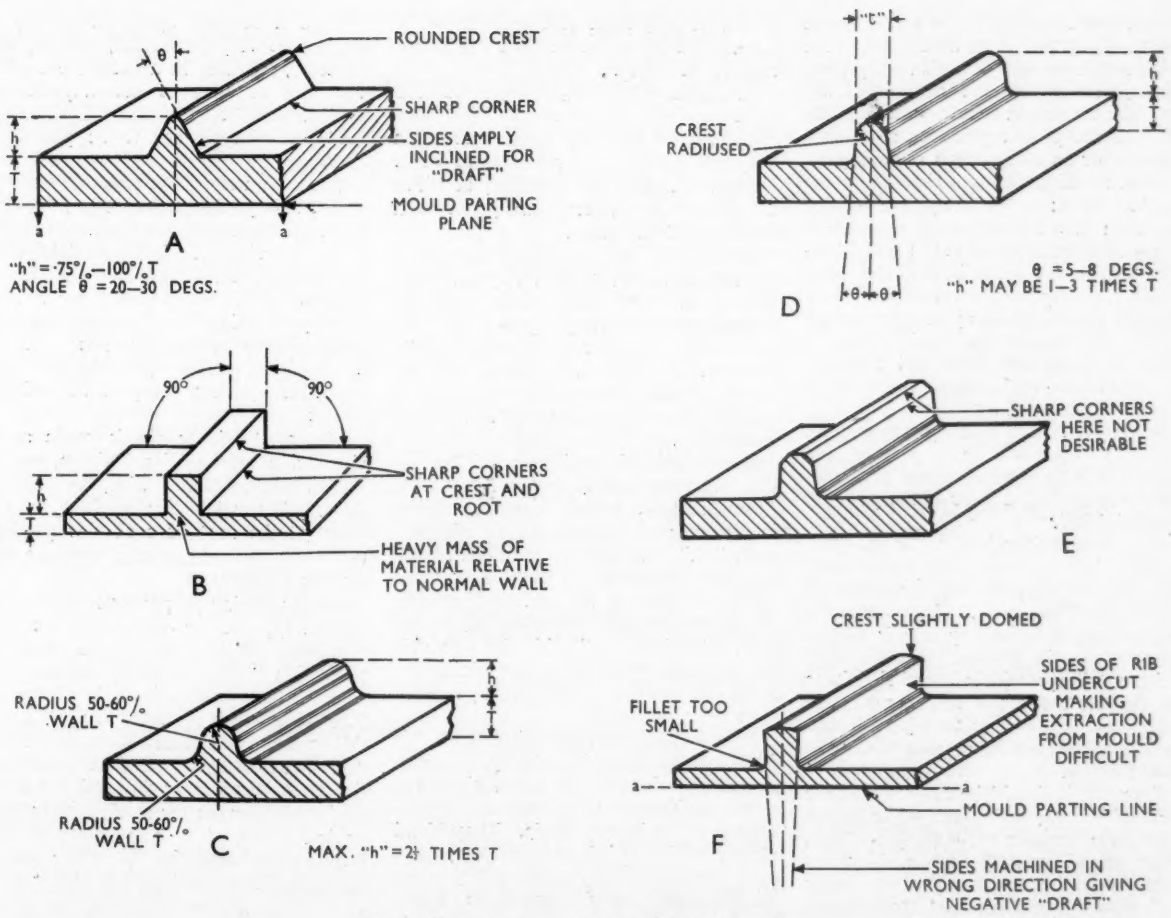

Fig. 1.—Common types of ribs for plastics mouldings.

Very sharp corners and edges are also much more difficult to mould, because of the sudden arrestation or interruption to the direction of flow, and the greater risks of damaging those portions when the component is ejected from the mould cavity.

One further important point deserves to be noted in respect of this kind of rib design. With the example given at A, it will be observed that a perfectly sharp corner is left at the root of the inclined sides where these join to the wall proper.

Such a sharp corner may not prove deleterious in cases where the wall thickness can be of sufficient magnitude. If, however, the wall is of very slender cross-sectional thickness, the presence of such a sharp corner might give rise to several troubles during moulding. For instance, the slender portions of the wall immediately surrounding the rib may be distorted due to the unequal shrinkage stresses, or the tendency towards cracking at the root of the rib may be increased, again because of the uneven contraction occurring at that point.

To avoid these tendencies it will be desirable to blend the sides to the wall with a small radiused fillet. This will also appreciably increase the strength of the ribbed portion.

By employing a considerable degree of inclination on the sides of the rib formation, little difficulty will be experienced when removing the finished article from the cavity, indeed the normal shrinkage of the solidifying component will tend to ease the part out of the cavity a slight amount, thereby promoting safer and quicker ejection.

With this component-rib design the mould parting surface is denoted by the line "a—a," which is situated along the lower edge of the wall. This means that the whole of the cavity formation for the wall and the channel for the raised rib can be machined wholly within one mould block. This, of course, is the simplest form of rib disposition, simplifying as it does the machining of the rib portions of the cavity. With this form of rib location the toolmaker will not be presented with awkward or difficult matching requirements on the rib, as would be the case if the parting line surface of the mould were to pass through the rib.

This kind of rib location should always be selected wherever possible, not only because it is the most economical to produce in the moulding tool, but also because it ensures a complete absence of flash along the crest of the rib, and thus will permit the buffing of the finished component to be performed with greater ease and speed and at less cost. The appearance of the finished part will likewise be maintained at a high level by the absence of a parting-line marking at the top of the rib. These may appear simple and relatively unimportant design considerations, yet it is exceedingly easy for the component designer, unfamiliar with mould-making provisions, to specify locations for ribs which will occasion these kinds of trouble and defect.

The type of rib shown at B is not to be recommended for several important practical reasons, which are worthy of note because they serve to illustrate certain features which should be strenuously avoided when evolving a component design.

In the first place, the shape of the rib is unsuitable in that the sides are disposed exactly at right angles to the face of the component wall. This means there will be no extraction "draft" provivded thereon, and as a result sticking and hanging of the article in the cavity formation can be expected.

Moreover, the rib is of an excessive height in relation to its width, and to the thickness of the wall on which it is joined. These two undesirable conditions will give rise to certain moulding difficulties, whether the part is produced as a compression or as an injection moulding.

The moulding difficulties liable to occur are as follows: In the first place they will result in the formation of an unduly heavy mass of material in the rib in contrast to that contained in the wall itself. This disparity will result in very unequalized contraction stresses occurring at the root of the rib, which would be liable to cause distortion and excessive warpage of the wall material immediately around the base of the rib.

Secondly, the rib itself by reason of its excessive height will be very weak, and its ability to serve as a stiffener or bracer for the unsupported walls of the part will be diminished.

Thirdly, the sides join to the wall in a perfectly sharp corner, and the absence of a fillet at this point will mean the rib will be relatively weak. If the moulding should happen to be very long in length, or extensive in surface area, features which entail appreciable lateral shrinkage on the part, the rib might easily be cracked at the root, or even bent before the component can be removed from the mould cavity.

Fourthly, it should be noticed that the crest of the rib is formed perfectly flat with sharp corners at each side. This, again, would occasion certain difficulties when machining the mould cavity. It is well known by toolmakers that greater difficulties attend the formation of sharp corners at the root of a cavity channel, than is the case if such portions may be formed with a slight radius. Cutter wear on a pointed tool is much more rapid than with one having suitable radii. Usually, to reproduce the former sharp-cornered kind of channel will require a greater amount of hand trimming and tooling than is the case with radiused channels.

The reproduction of rib channels having perfectly square sides of the character depicted will also entail additional care on the part of the toolmaker when machining, so as to ensure that no undercut portion is formed at the root of the rib, or that the surfaces of the channel sides do not become torn and roughened by the passage of the cutter.

It would, of course, materially improve this form of rib if its crest were to be domed or even radiused off completely to a half circle. This would not only simplify the cavity machining requirements, but would also result in the sides of the rib being reduced considerably in height, thus ensuring that the extraction of the part from the cavity would be accomplished with greater ease.

Because of the foregoing drawbacks this form of rib should not be employed. It would only prove practicable where the height of projection of the rib could be maintained at not more than about one half of its width.

The kind of rib design illustrated at C is in very widespread use and possesses the merit of pleasing appearance when disposed on an external surface of a component. It is also extremely useful as a stiffener for strengthening the wall structure of an article.

This form of rib comprises three radiused portions, blended very smoothly with each. The radius of the rounded crest is approximately equal to that of each side portion joining on to the wall of the part. The radii of the fillets each side of the rib may form 50-60 per cent. of the normal wall thickness ("T") of the component.

The height of projection of the rib ("h") may be varied within fairly wide limits, and as a maximum should be about two and a half times the thickness wall, "T." The greater the height "h," the larger should be the radii of the three curves composing the rib. The radii should in fact be made about 40-50 per cent. of height "h," with the two side curves forming the fillets for joining the rib to the wall being made slightly smaller than the crest radius.

It will be understood that with this form of rib there is actually no plain straight portion at the sides, since the respective curves at these two points are quarter-circle in magnitude. They blend closely to the half-circle of the crest portion. This will mean in practice that the minimum amount of drag will be offered to the extraction of the component, because the curved formation of the rib will possess ample draft.

Care will be required when blending the curves to each other to avoid leaving a slight depression, or groove, as this would constitute a shallow undercut which would offer increased resistance to ejection.

Very little difficulty will be encountered during the moulding and removal of the component with such a rib which is correctly formed according to this design. It is extremely strong and serves excellently for increasing the rigidity of a component having thin wall section and liable to excessive distortion or warping.

There is, however, one particular drawback worthy of note. Some objections may be experienced by the toolmaker when machining the female form of cavity channel for this shape of rib.

Its reproduction in the mould will entail the use of a specially formed end-milling cutter, carefully pre-formed to the re-entrant curved formation. Failing the use of such a specially shaped cutter, an ordinary round-ended milling tool may be used. The straight sides and sharp corners thus left by such a cutter on the rib channel would have to be removed by hand filling and tooling means to the requisite fillet curvature.

Such a manual operation would, of course, be very protracted, tedious, and exacting, resulting in a great increase in the time required to manufacture the mould, and a commensurate addition to the costs and charges to be passed to the client.

The design shown at D is perhaps the most widely acceptable form of rib favoured by mould designers. With this design the sides of rib are straight, each one being inclined anything from 5-8 degrees from the vertical as shown, thereby ensuring that the width at the crest will be appreciably less than the width at the root, to give the necessary draft for ejecting the part out of the cavity.

The crest of the rib is made semi-circular in cross-sectional shape, and it blends out smoothly with the straight sides. A small radius or fillet is provided at the root of each side portion, this being blended evenly with the top surface of the wall.

Good working proportions of the sizes of this type of rib, relative to the wall thickness, are as follows: The height of projection "h" may safely be made as much as two or three times the dimension "T," although it is customary to restrict this to about one to one-and-a-half times "T." Where the height is to be made three times the thickness of the wall, it will be advisable to make the straight sides with an inclination of 8 degrees, and also to increase the radius of the side fillets at the root. The maximum thickness "t" of the rib, measured across the root portion as depicted, should be maintained from about 75-80 per cent. of the height "h." The radii of the side fillets joining the rib to the wall should preferably be from one-quarter to one-third the thickness "t." These proportions will, of course, determine the radius of the crest portion.

When correctly proportioned this is an excellent type of rib, the reproduction of which will entail little difficulty for the mould maker. It ensures a very uniform thickness of material through the wall formation, and, moreover, enables the moulding to be readily extracted from the cavity during ejection. It is also of considerable strength, rendering the form particularly applicable as a stiffener or bracer for joining together large unsupported slender wall portions. This type of rib is very often employed for bridging heavier bossed-up sections of the component, either by diagonal or single line disposition.

Another design E shows a slightly modified form of the preceding shape of rib, which is sometimes used. The shape is substantially the same as that of example D, with the exception that the crest is not rounded, but is composed of three narrow flat portions, in the fashion depicted.

The necessary channel cavities for this kind of rib will be similarly capable of easy reproduction, by means of a simple tool.

If this rib form is maintained reasonably low in height above the surface of the wall its appearance value will be enhanced, since there will be five flat surfaces disposed at varying angles to each other, thus giving good light reflecting features.

When machining the channel cavities for such a type of rib, it will be advisable to leave a very tiny radius at the corner of each flat portion comprising the crest, so that razor edges will be eliminated on the rib of the component.

The last example, shown at F, indicates several very undesirable features of rib design which must be carefully guarded against when developing a component design form. With this kind of rib it will be specially noted that the height is very considerable in comparison with the wall thickness of the component. In practice this will mean that the stiffening properties of the rib will be seriously diminished.

Further, the sides of the rib are straight and inclined in the wrong direction to allow the finished moulding to be easily extracted from its cavity. The width at the crest is, in fact, greater than at the root, this being shown to a somewhat exaggerated degree on the illustration. If the difference between the two widths "a" and "b" were to be only a matter of a few thousandths of an inch, considerable sticking would arise when attempting to remove the part from the cavity.

The radius at the sides where the rib joins to the wall is insufficient, thus forming yet another source of weakness attaching to the design element. The mould parting surface is along line "a—a" as with all the preceding examples, thus embracing the formation of the entire rib channel in one mould block.

Such a rib located upon an external surface of a component would prove most unsatisfactory either from the appearance viewpoint, or as a means for strengthening the article. This reverse tapered rib form could, however, be moulded, but it would necessitate parting the mould in a different plane, i.e., at 90 degrees to the one shown at "a—a," the parting thus passing centrally along the rib.

Such a mould construction would then raise additional problems for the toolmaker in that half of the rib formation would have to be machined in each mould block, and these would have to be very accurately matched up, so that no misalignment or steps would be formed at the crest of the rib. To accomplish this would entail greater care, longer toolmaking time, and added cost to the tool.

(To be continued.)

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 2/- each.

B.P. 641,437. Appl. 31.5.47. Conv. (U.S.A.) 10.10.45. Acc. 9.8.50.

Manufacture of N-vinyl compounds. H. Beller, R. E. Christ and F. Wuerth. To: General Aniline and Film Corp. See also B.P. 641,438.

B.P. 641,442. Appl. 1.8.47. Conv. (U.S.A.) 16.10.40. Acc. 9.8.50.

Polymers and process of producing same. F. K. Schoenfeld and W. L. Semon. To: B. F. Goodrich Co.

Refers to methods of polymerization of vinyl chloride, vinylidene chloride or mixtures of these or with other ethylenic compounds.

B.P. 641,576. Appl. 16.1.48. Acc. 16.8.50.

Seaming plastic-coated fabrics. D. Gallacher. To: Ioco, Ltd.

Method of joining plastic-coated fabrics consists of interposing a sheet of thermoplastic material in the seam, stitching the material and subsequently welding by high frequency the interposed strip of thermoplastic material to the plastic coating.

B.P. 641,611. Appl. 31.10.47. Conv. (Belgium) 13.2.47. Acc. 16.8.50.

Method of fusing thermoplastic tubes. Bell Telephone Manufacturing Co. To: Standard Telephones and Cables, Ltd.

Method of lap-welding the ends of thermoplastic inner tubes for bicycles, etc. An L-shaped electrode is inserted into the tube and H.F. welding takes place between this and an outer electrode. The inner electrode is withdrawn after welding through a hole which is subsequently used for the inflating valve. Several other forms of continuous roller welding are mentioned.

B.P. 641.647. Appl. 17.12.46. Conv. (U.S.A.) 24.10.45. Acc. 16.8.50.

Apparatus and method of moulding plastic materials. To: Polymer Corp.

Special form of extrusion moulding of comparatively long bar or rod shapes, particularly from polyamides, consists of a telescopic system of a cylinder which is heated and contains the plastic material and a hollow elongated mould, which is moved under pressure into the cylinder. After cooling the moulding is withdrawn without difficulty owing to the shrinkage of the plastic material.

B.P. 641,653. Appl. 2.5.47. Conv. (U.S.A.) 19.6.46. Acc. 16.8.50.

Process for preparing a stable aqueous emulsion of polymerized, normally liquid, water insoluble polymerizable compounds. To: Shawinigan Resins Corp.

B.P. 641,679. Appl. 2.1.48. Conv. (U.S.A.) 15.1.47. Acc. 16.8.50.

Co-polymerization of ethylene and vinyl chloride. To: E. I. du Pont de Nemours and Co.

B.P. 641,697. Appl. 12.2.48. Conv. (U.S.A.) 27.10.44. Acc. 16.8.50.

Urea-formaldehyde resins. P. S. Hewett. To: Beck, Koller and Co. (England), Ltd.

Reaction by heating of urea and a 37 per cent. aqueous solution of formaldehyde in the molar ratio of 1 part urea to 2-2.5 parts of formaldehyde, 2-step process.

B.P. 641,832. Appl. 21.1.48. Acc. 23.8.50.

Plastic organic polymer compositions. H. Steiner, H. S. Boyd-Barrett and J. R. Holker. To: Petrocarbon, Ltd.

Refers to plasticizers for the production of polymeric thermoplastic substances. Dialkyl esters of diphenic acid are used for plastifying cellulose acetate, polyvinylacetals, styrene compounds, acrylic and methacrylic acid esters, etc.

B.P. 641,903. Appl. 3.9.47. Acc. 23.8.50.

Production of artificial articles from polymerizable material. To: I.C.I., Ltd.

Manufacture of polymerized sheet materials between metal surfaces (e.g. stainless steel bands) where the metal is coated with a lining of a film made from water-soluble polyvinyl alcohol and ethylene glycol, triethanol amine, glycollic acid, etc. This coating permits easy stripping of the polymerized article from the metal surfaces. See also B.P. 641,904.

B.P. 641,961. Appl. 24.6.47. Acc. 23.8.50.

Rotary mould table presses for moulding tablets and the like from material in powder form. C. E. Courtoy.

Moulding press for the manufacture of tablets and preforms comprising a rotatable table with upper and lower dies, moving with the table. The maximum moulding pressure can be controlled through the medium of a liquid column under pressure.

B.P. 641,989. Appl. 5.12.47. Acc. 23.8.50.

Manufacture of patterned thermoplastic strip material. J. Veit. To: Duratube and Wire, Ltd.

Method of providing embossing and similar effects to strip extrusions. A wire or other metal strip is placed in front of the extruding die and imparts movement at right angles to the extrusion plane to the strip material, thus producing a "corrugated" effect of the finished article.

B.P. 642,041. Appl. 5.2.48. Conv. (U.S.A.) 23.8.46. Acc. 23.8.50.

Manufacture of stable synthetic resins. P. S. Hewett and R. E. Carter. To: Beck, Koller and Co. (England), Ltd.

B.P. 642,780. Appl. 20.1.48. Conv. (U.S.A.) 23.4.43. Acc. 13.9.50.

Production of potentially heat re-active thermosetting resins and infusible resins and resinous products obtainable therefrom. M. T. Harvey. To: Harvel Research Corp.

A furfuraldehyde is reacted with a ketone under alkaline conditions to produce a thermoplastic resin.

B.P. 642,799. Appl. 24.3.48. Conv. (Canada) 27.3.47. Acc. 13.9.50

Polymerization of 4-vinylcyclohexene dioxide. To: Canadian Industries, Ltd.

Improved method of polymerization for this compound, limiting the polymerization temperature to a range between 50 degrees and 100 degrees C. to prevent the occurrence of cracking which may take place at higher temperatures. See also B.P. 642,800, B.P. 642,983, and B.P. 643,950.

B.P. 642,828. Appl. 26.11.47. Conv. (U.S.A.) 15.6.43. Acc. 13.9.50.

Convertible alkyd resins. T. W. Evans and D. E. Adelson. To: N. V. de Bataafsche Petroleum Mij.

Alkyd resins prepared by reacting a dicarboxylic acid or an anhydride of this with a compound of the general formula:—

$$R-O-R^1$$

where R is an unsaturated group containing an olefinic double bond and R^1 is glycerol minus one hydroxyl group or glycidol minus one hydroxyl group.

B.P. 642,837. Appl. 20.2.48. Conv. (Switzerland) 21.2.47. Acc. 13.9.50.

Printing or dyeing superpolyamide fibres. To: Ciba, Ltd.

B.P. 642,901. Appl. 14.3.47. Conv. (Sweden) 6.9.45. Acc. 13.9.50.

Multi-layer heat insulating material. To: A.B. Isoflex.

Heat insulating material is built up from a number of layers of thin foils of 0.02–0.05 mm. thickness, the foils consisting of polystyrol, polyvinylchloride and/or silicone polymers. Better insulation properties are claimed in comparison to materials from cellulose acetate.

B.P. 643,018. Appl. 3.3.47. Conv. (U.S.A.) 1.3.46. Acc. 15.9.50.

Polymerization of organo siloxanes. E. L. Warrick. To: Corning Glass Works.

B.P. 643,045. Appl. 17.12.47. Conv. (U.S.A.) 18.2.47. Acc. 15.9.50.

Polymerization processes and the products obtained thereby. S. Smith III. To: Monsanto Chemical Co.

Refers to emulsion polymerization of styrenes, isoprenes, etc.

B.P. 643,064. Appl. 31.3.48. Conv. (U.S.A.) 24.12.47. Acc. 15.9.50.

Ethyl cellulose hot melt coatings. G. H. Pyle. To: Hercules Powder Co.

Improvement of the colour stability of ethyl cellulose hot melt compositions by incorporation of stabilizers; 1.0 to 10 per cent. of a lower alkyl ester of oxalic acid is added to the ethyl cellulose compound and colour stability is claimed up to 150 + 200 degrees C.

B.P. 643,169. Appl. 6.8.47. Acc. 15.9.50.

Manufacture of co-polymers. J. Downing and J. G. N. Drewitt. To: British Celanese, Ltd.

Emulsion polymerization of vinyl chloride with acrylonitrile in the presence of a peroxy compound as a catalyst. The product is used for the melt-spinning of synthetic fibres, production of films or foils and as a moulding composition. See also B.P. 643,198.

B.P. 643,219. Appl. 4.6.48. Acc. 15.9.50.

High frequency dielectric heating apparatus. R. K. Downing. To: Communications Patents, Ltd.

Electrodes for H.F. welding machines for the manufacture of articles from thermoplastic sheet material such as polyvinyl chloride.

B.P. 643,348. Appl. 27.8.47. Conv. (U.S.A.) 26.3.47. Acc. 20.9.50.

Improvements in plastic composition. W. W. Koch and A. L. Rummelsburg. To: Hercules Powder Co.

Stabilization of cellulose ether compositions by the incorporation of paracyclohexyl phenol and sulphur dioxide or a compound releasing sulphur dioxide under heat. Improved weather resistance and colour stability are claimed for the products.

B.P. 643,388. Appl. 29.12.47. Acc. 20.9.50.

Production of polymeric materials. H. G. Plant and R. H. Griffith. To: The Gas Light and Coke Co.

Polymeric material which can be drawn into fibres is based on heat condensation in an inert atmosphere of benzophenone dicarboxylic acid or an ester of this and a glycol of the series HO $(CH_2)_n$ OH. A metal of low atomic weight (e.g., magnesium) is used as a catalyst.

B.P. 643,453. Appl. 17.10.46. Conv. (Holland) 22.1.43. Acc. 20.9.50.

Mouldings of synthetic resin material suitable for high tension insulation. To: N. V. Philips Gloeilampenfabrieken.

The moulding powder is divided into small quantities prior to moulding, inspected for metallic impurities by X-rays; only the material which has passed this test satisfactorily is used for the moulding of high tension insulators.

B.P. 643,463. Appl. 28.3.47. Acc. 20.9.50.

Improvements in and relating to the printing of polyvinyl resins. L. W. E. Townsend and E. C. Bate. To: Associated Technical Manufacturers, Ltd.

Printing process based on the use of printing inks composed of a pigment or dyestuff, vinyl chloride/vinyl acetate co-polymer resin and a solvent for the co-polymer. A plasticizer compatible with the co-polymer may also be incorporated in the compound.

B.P. 643,472. Appl. 27.6.47. Conv. (France) 3.6.46. Acc. 20.9.50.

Process and machine for packing tablets and similar articles. C. Nicolle.

Manufacture of multi-unit packs for tablets or similar products from sheet plastic material (e.g., cellulose acetate). Tablets are deposited on a continuous film in prearranged disposition, another film is laid on top of the goods and individual pockets are heat-formed in the upper film by a number of simultaneously operating press members. Dividing lines between the tablets may be perforated for ease of tearing individual units from the pack.

B.P. 643,527. Appl. 30.12.47. Conv. (Belgium) 30.1.45. Acc. 20.9.50.

Production of polymeric material. To: Sté Belge de l'Azote du Marly.

Process for production of polymer based on subjecting a volatile polymerizable organic compound to polymerizing conditions in a reactor provided with a reflux condenser capable of condensing the whole of the vapour and returning the condensed liquid to the reactor. Correct polymerization temperature is maintained by means of a thermostatically controlled heater.

B.P. 643,550. Appl. 22.3.48. Acc. 20.9.50.

Sealing devices for submarine electric cables. R. W. Presswell. To: Submarine Cables, Ltd.

An injection moulded polythene sleeve of a special shape is used to block the entrance of water to the conductor in submarine cables. The polythene sleeve may be adhered to a metal surface through an intermediate layer of polyisobutylene. (See B.P. 618.345.)

B.P. 643,742. Appl. 23.9.47. Acc. 27.9.50.

Packaging of liquid or solid material, and the packaging of small objects or articles. H. Senior and J. Skene Brown. To: Cascelloid, Ltd.

Manufacture of small packages for powders and liquids, using strips of thermoplastic material such as polyvinyl chloride, sealing the strips at regular intervals, filling the pockets thus produced and finally sealing the remaining end of the bags. Sealing is carried out by infra-red heating, high-frequency welding or in some instances with a small gas flame. Cutting off of individual parts is carried out subsequently.

B.P. 643,750. Appl. 20.11.47. Conv. (U.S.A.) 4.1.47. Acc. 27.9.50.

Thermosetting moulding compositions. H. P. Wohnsiedler. To: British Industrial Plastics, Ltd.

Manufacture of small articles, such as buttons, in the form of unfilled mouldings. An intermediate melamine formaldehyde resin is heated in the presence of an acid or acid liberating curing agent to advance polymerization far enough to enable the composition to be rapidly cured directly after being put into the mould, but still permitting sufficient flow of the material in the mould.

B.P. 643,752. Appl. 24.11.47. Conv. (U.S.A.) 21.12.46. Acc. 27.9.50.

Clear, smooth surfaced, bubble free castings of a polymerized vinylidene compound. To: B. F. Goodrich Co.

Method of producing clear castings for optical purposes based on mass polymerization of certain liquid polymerizable esters of alpha-substituted acrylic acid. Typical examples of these esters are: Methyl, ethyl, butyl and isobutyl methacrylates.

B.P. 643,845. Appl. 1.5.46. Acc. 27.9.50.

Process for producing shaped products from thermosetting syntnetic resins. W. H. Chapman and M. Goldstaub. To: Dunlop Rubber Co., Ltd.

An incompletely condensed syrup of a phenol formaldehyde resin is fed into a mixing chamber, mixed with a hardening catalyst and fed under pressure into a glass-lined mould. A gas-forming substance is incorporated in the syrup and reacts with the catalyst to form a foamed resin composition in the mould prior to final condensation.

B.P. 643,847. Appl. 7.10.46. Acc. 27.9.50.

Plastics moulding machine. W. W. Triggs. Comm. from: Improved Paper Machinery Corp.

Automatic moulding process using an extrusion machine for injecting the plastic material into a mould which is incorporated in a hydraulic press and permits moulding of the article under application of considerable pressure. Operation of the extruder and compression moulding machine is interlinked by a hydraulic control system to make the process fully automatic.

B.P. 643,853. Appl. 3.1.47. Conv. (U.S.A.) 13.4.46. Acc. 27.9.50.

Medicinal capsules and process of manufacture. To: Ely Lilly and Co.

Process for manufacture of capsules by dipping metal formers into a viscous solution of methyl cellulose with a methoxyl content of 25 to 35 per cent. and a viscosity of 7 to 15 centipoises.

B.P. 643,855. Appl. 9.1.47. Conv. (U.S.A.) 19.1.46. Acc. 27.9.50.

Apparatus for moulding articles from plastic materials. To: The Gora-Lee Corp.

Automatic moulding machine for rubber or plastic materials, comprises a system of co-operating wheels with mould cavities provided at their circumferences. The plastic material is fed into these cavities and formed into shape during rotation of the wheels.

B.P. 643,941. Appl. 9.6.48. Conv. (U.S.A.) 21.6.47. Acc. 27.9.50.

Organo silicon compounds. To: British Thomson-Houston Co.

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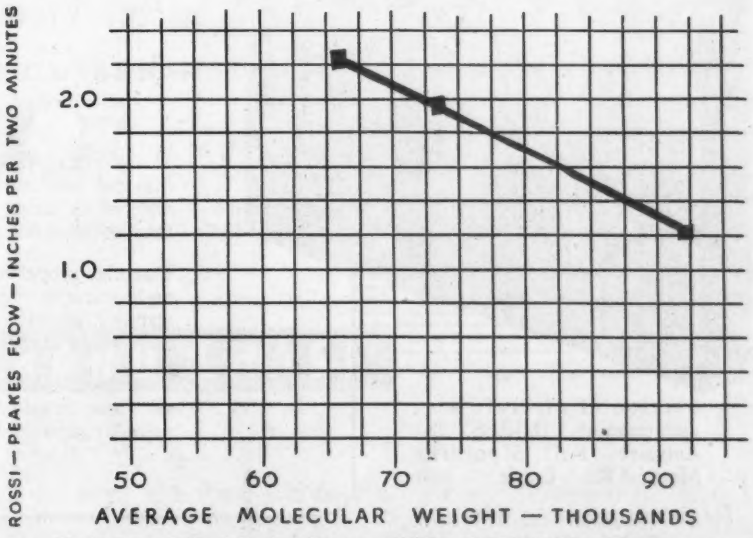

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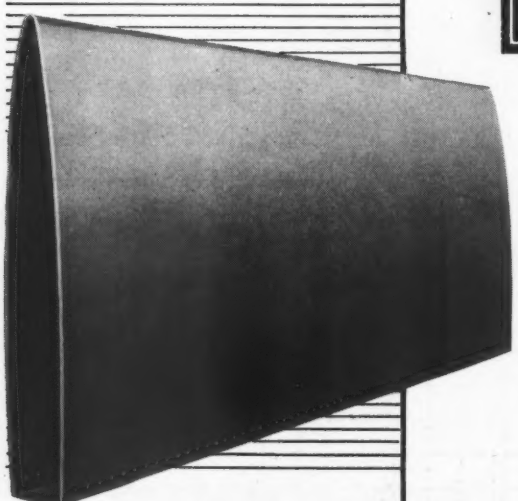

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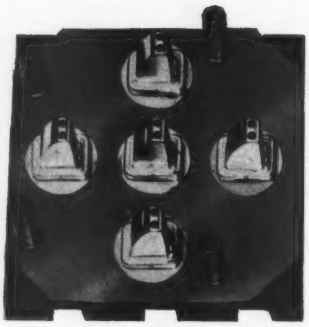

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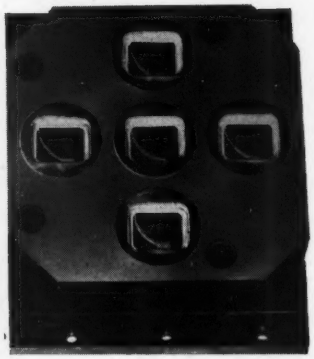

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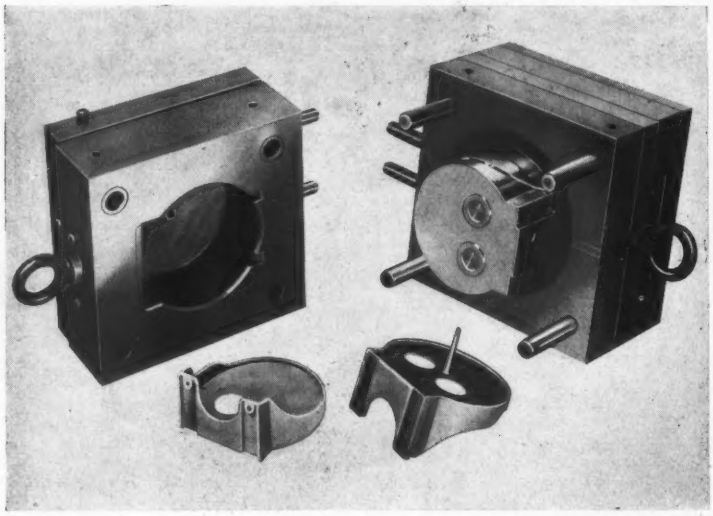

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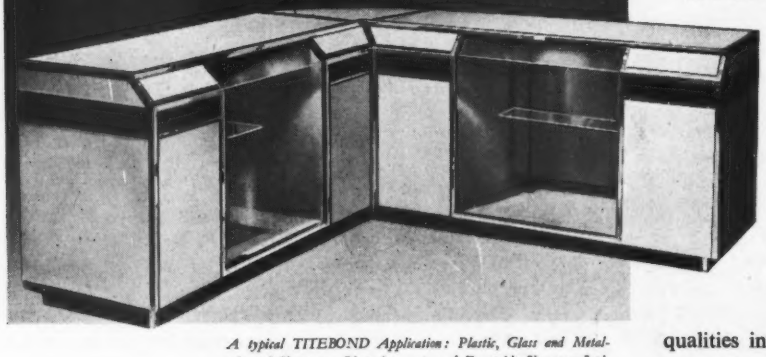

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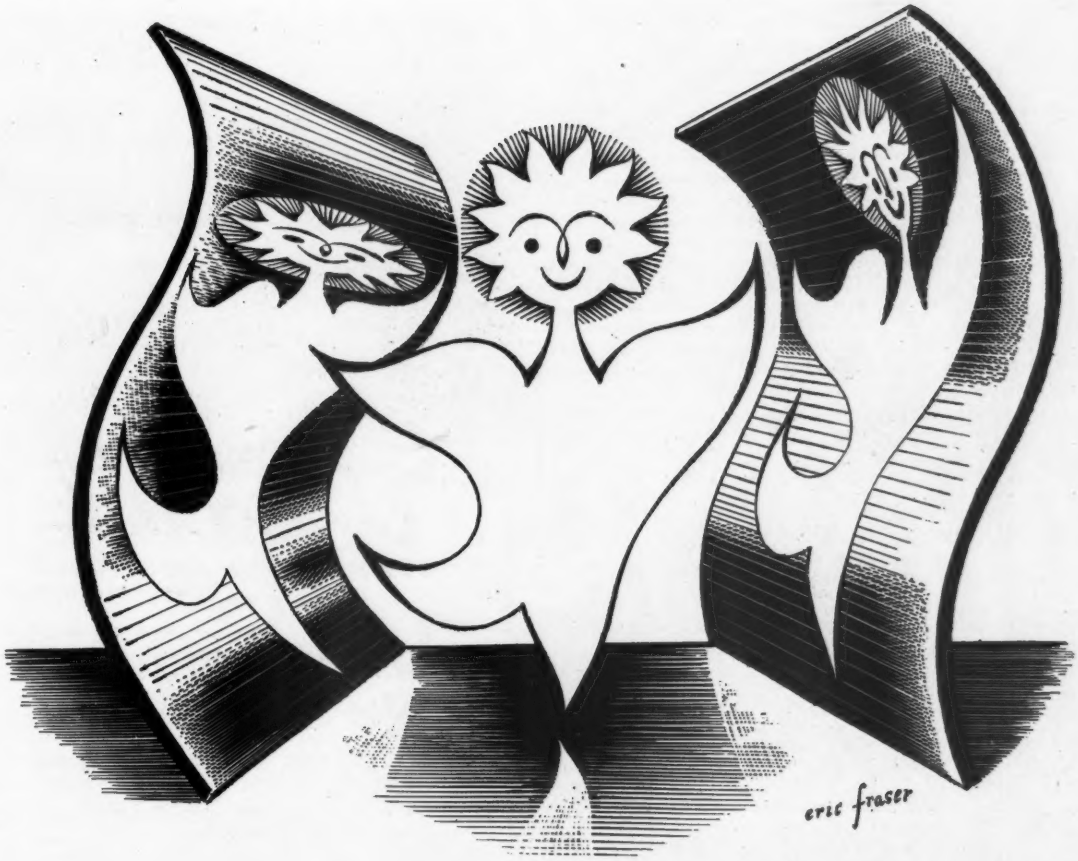

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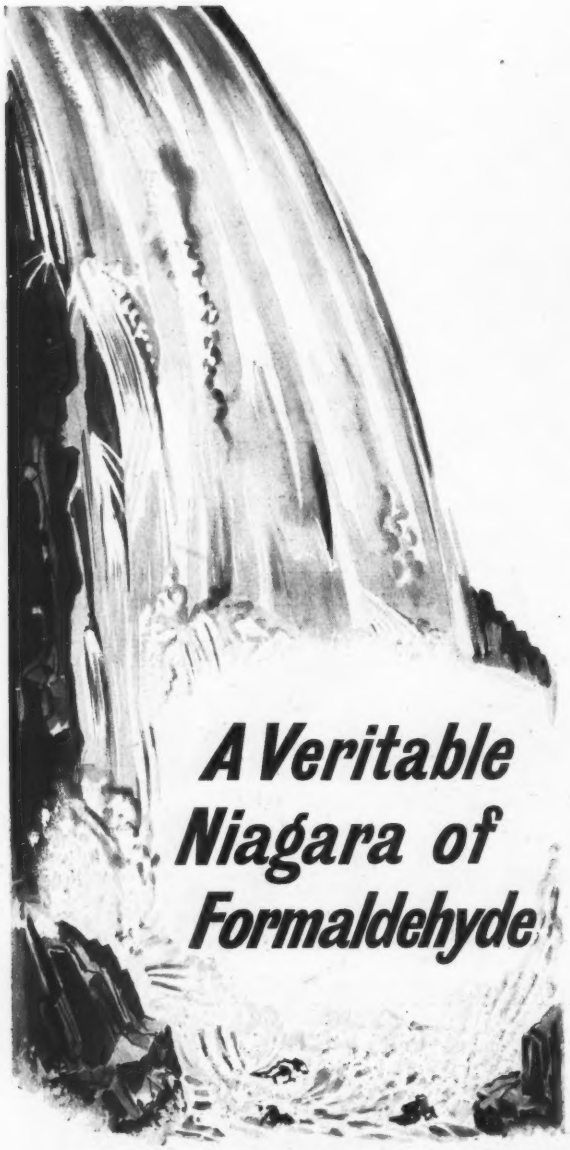

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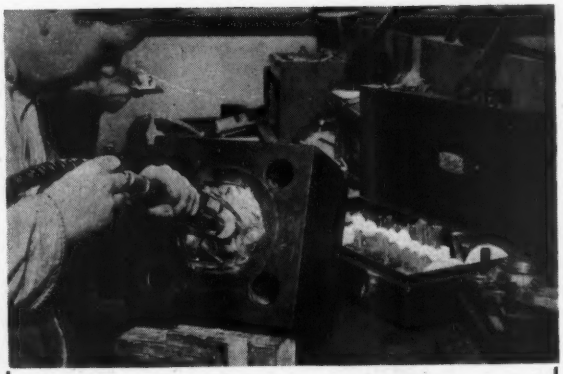

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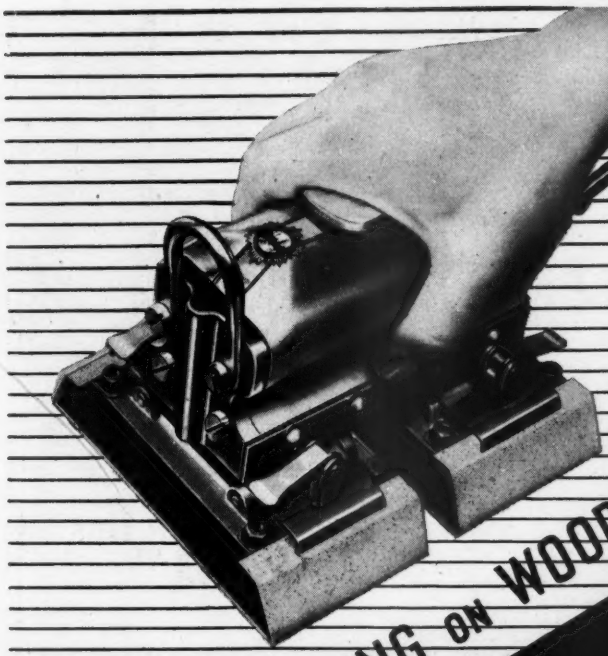

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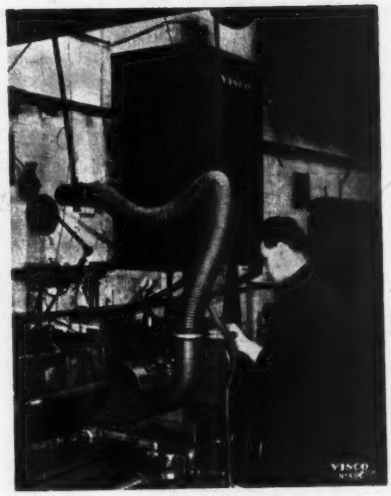

"Visco" unit on wall and connected by flexible hose to grinder.
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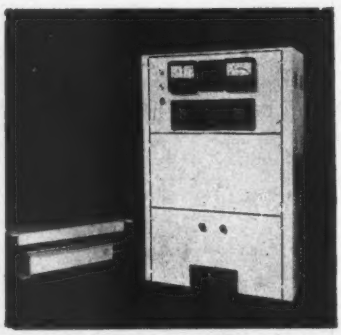

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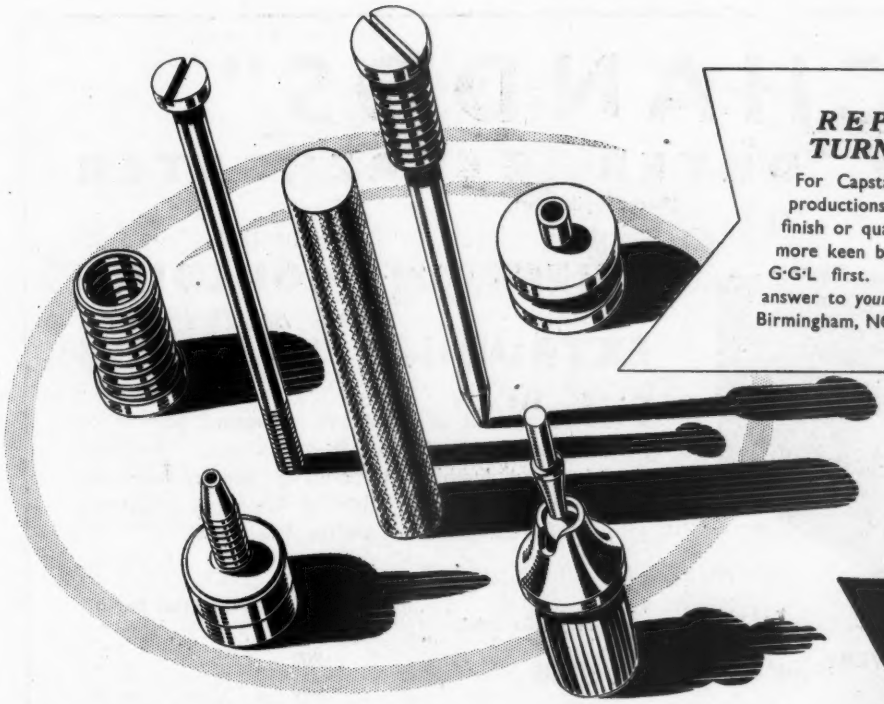

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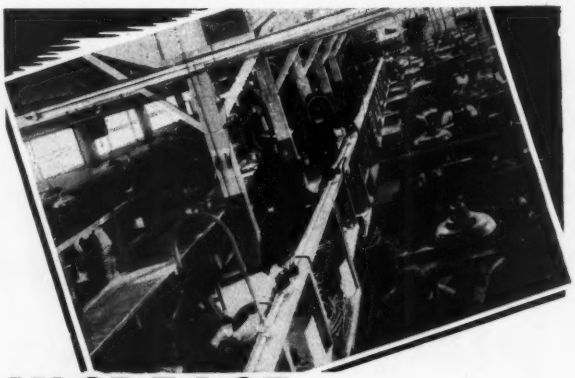

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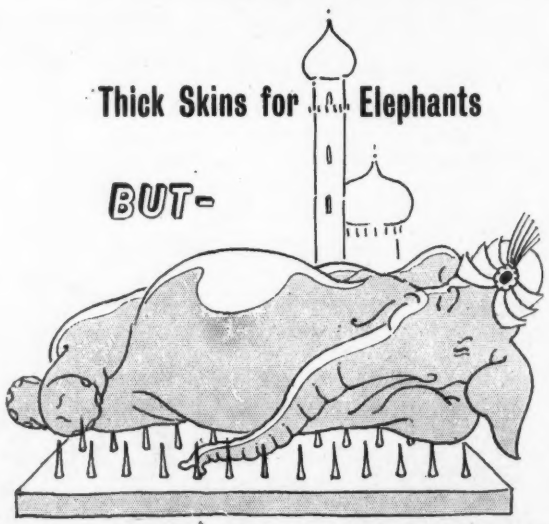

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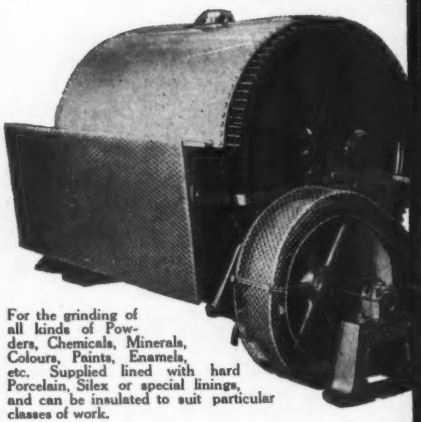

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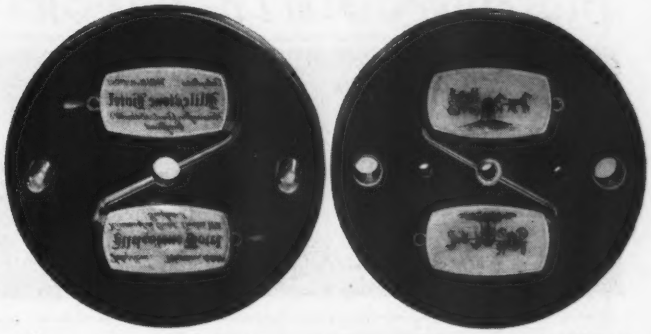

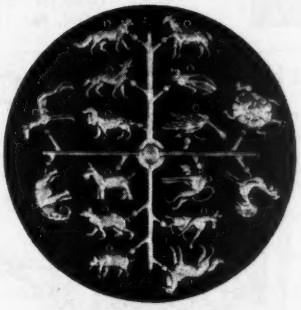

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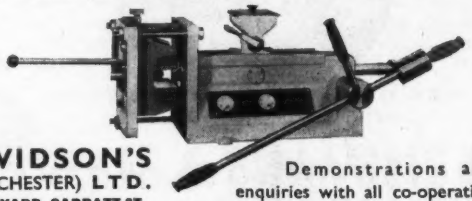

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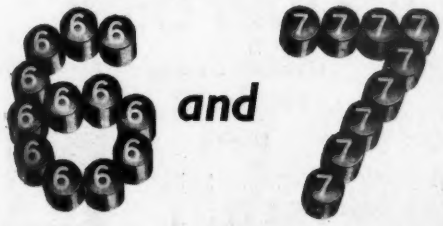

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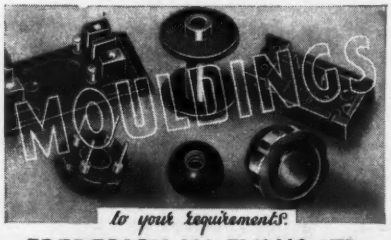

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BOOKS AND PUBLICATIONS

WANTED. Back numbers of Plastics Institute Transactions as follows: Nos. 3, January, 1933; 5, January, 1934; 6, July, 1934; 7, January, 1935; 10, June, 1936. Please write Box P5814, care of "Plastics." 162-25

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DESIGN AND DRAWING CAPACITY for plastic moulds (injection, compression, transfer), and component design development. Graystone Designs, 35 Winchester Road, Hampstead, N.W.3. Phone, Pri 7420. zzz-278

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CABLE WORKS, N. London, require a young chemist. Knowledge of chemistry to at least intermediate standard is required. Some practical experience of plastics extrusion would be an advantage. Apply, giving training experience and salary required to Box P6131, care of "Plastics." 162-24

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CHARGE HAND wanted for injection moulding shop, N.W. area. Applicants must have knowledge of tool fitting, etc., in addition to moulding experience. Apply with full particulars of experience to Box P6114, care of "Plastics." 162-21

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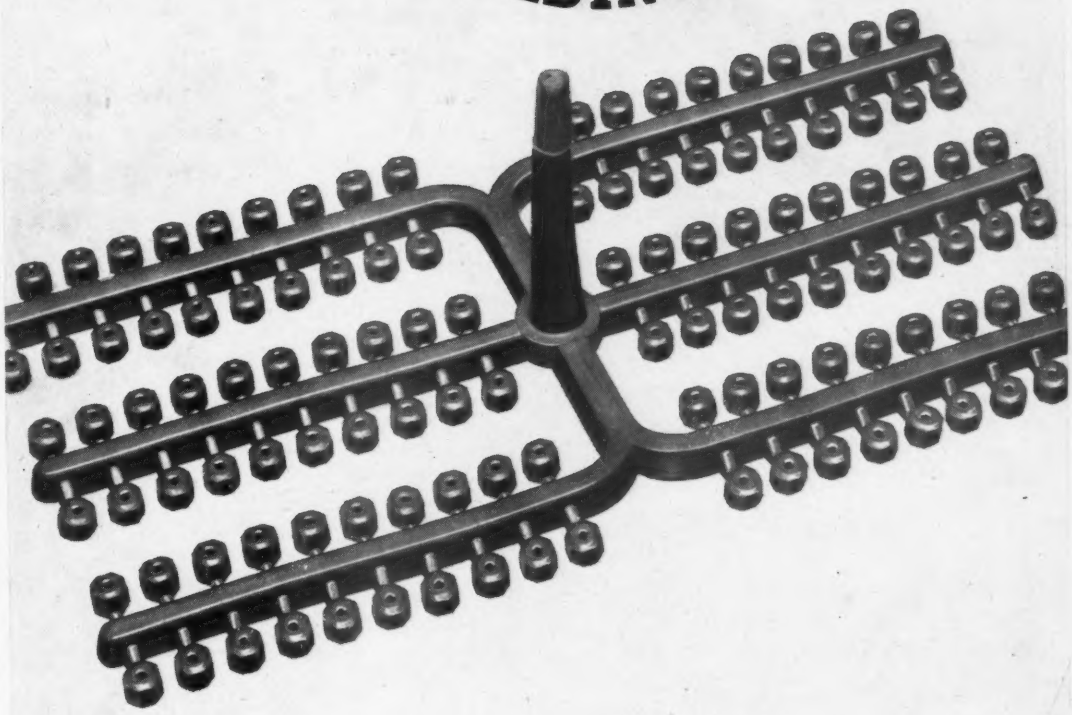

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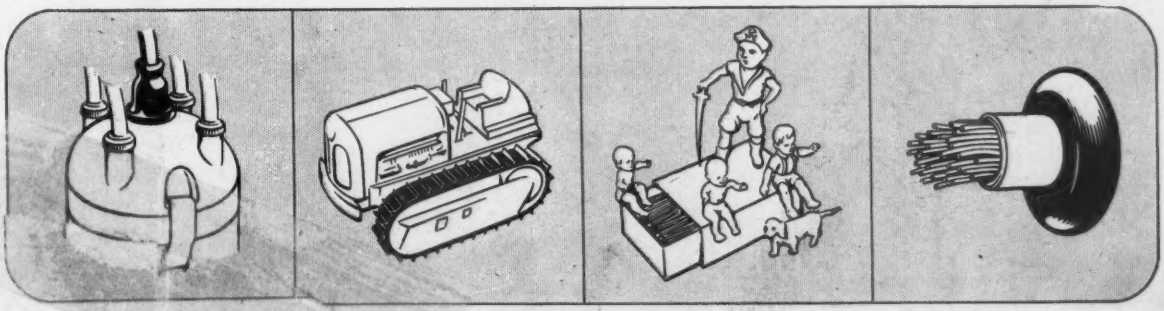

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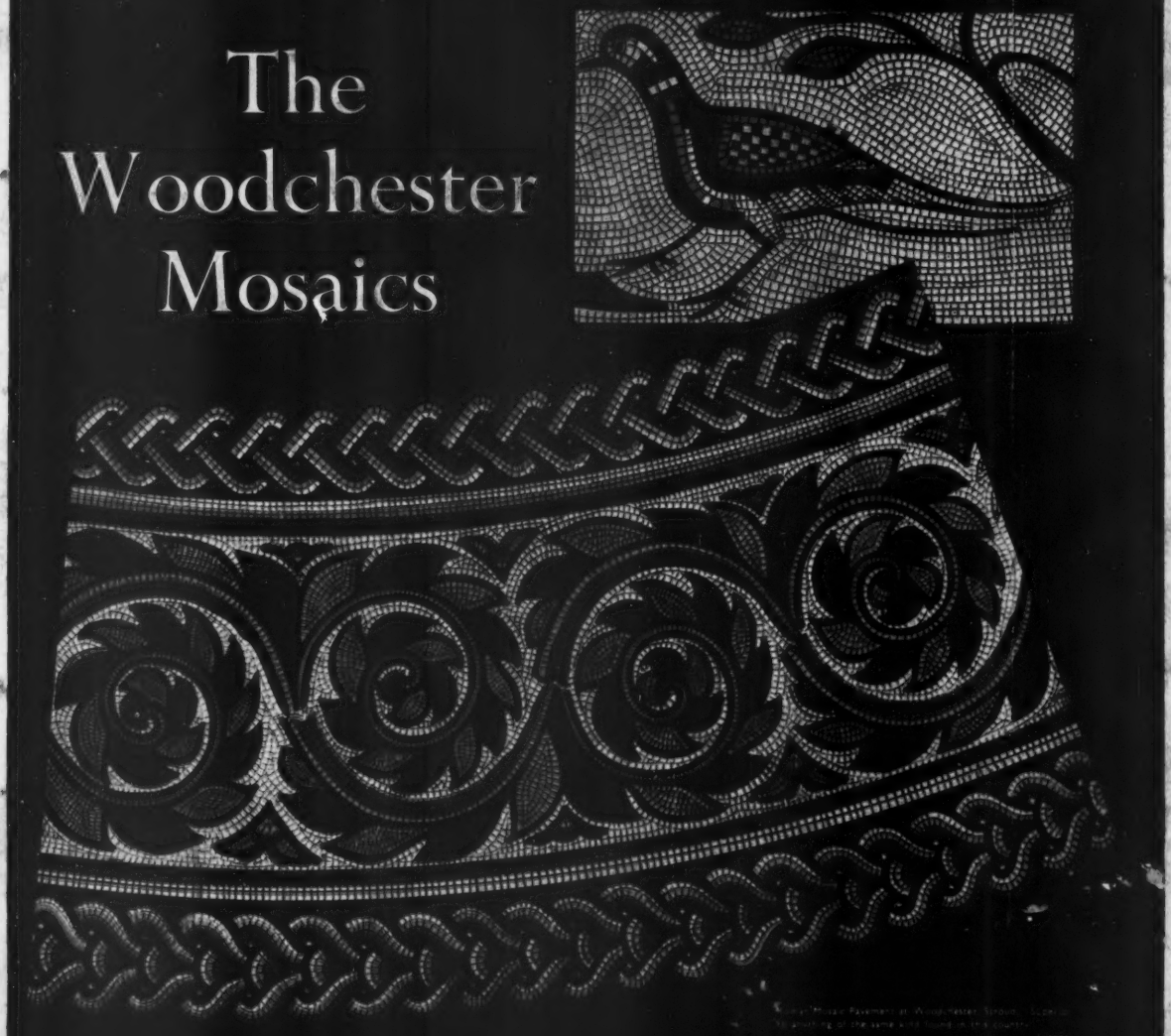

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